The WHAT'S NEW magazine
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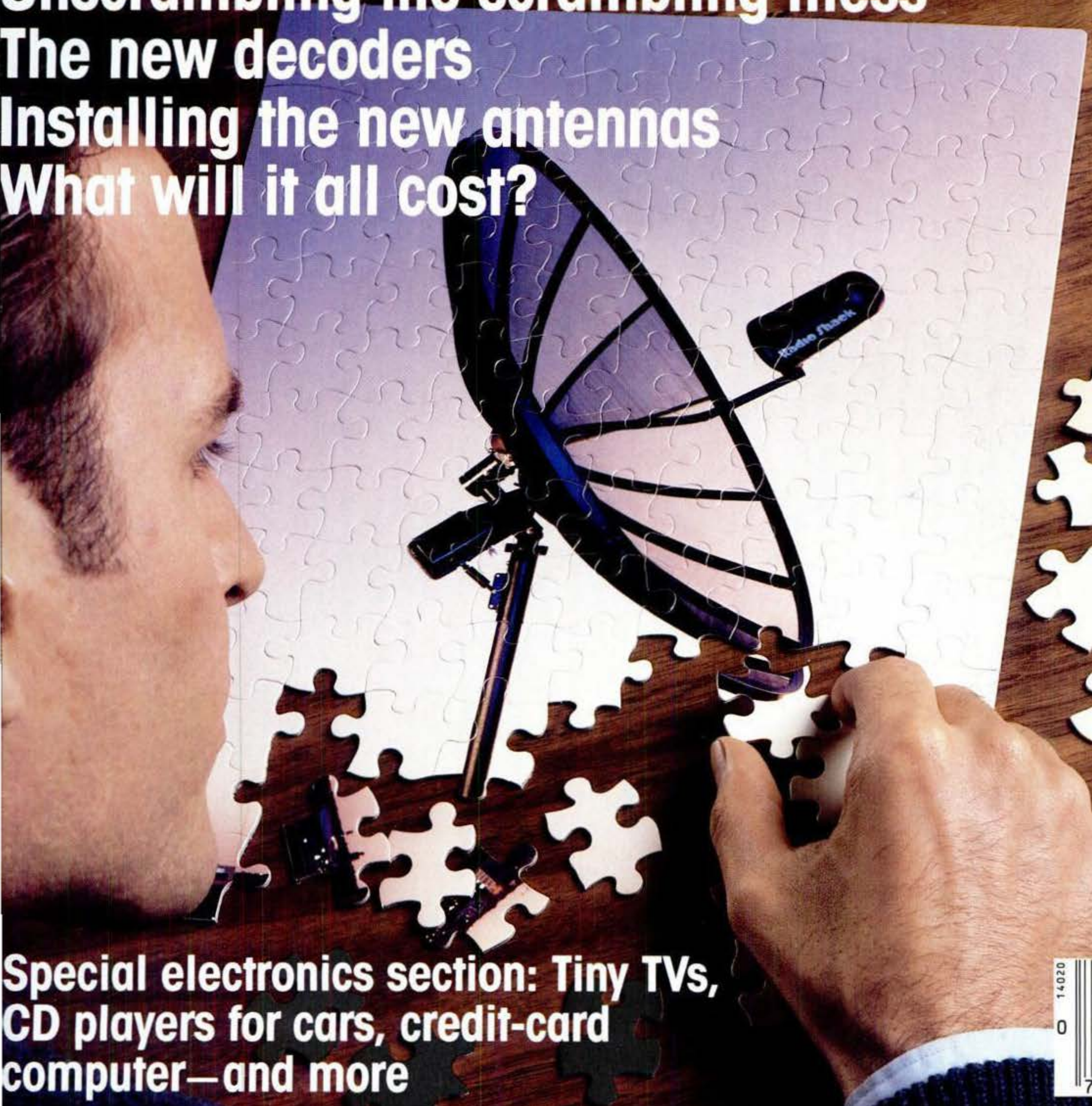
# Popular Science

Tailored 4WD power for all-out performance

Track tests: 3 sports coupes

# THE SATELLITE TV PUZZLE

Unscrambling the scrambling mess
The new decoders
Installing the new antennas
What will it all cost?



Special electronics section: Tiny TVs, CD players for cars, credit-card computer—and more

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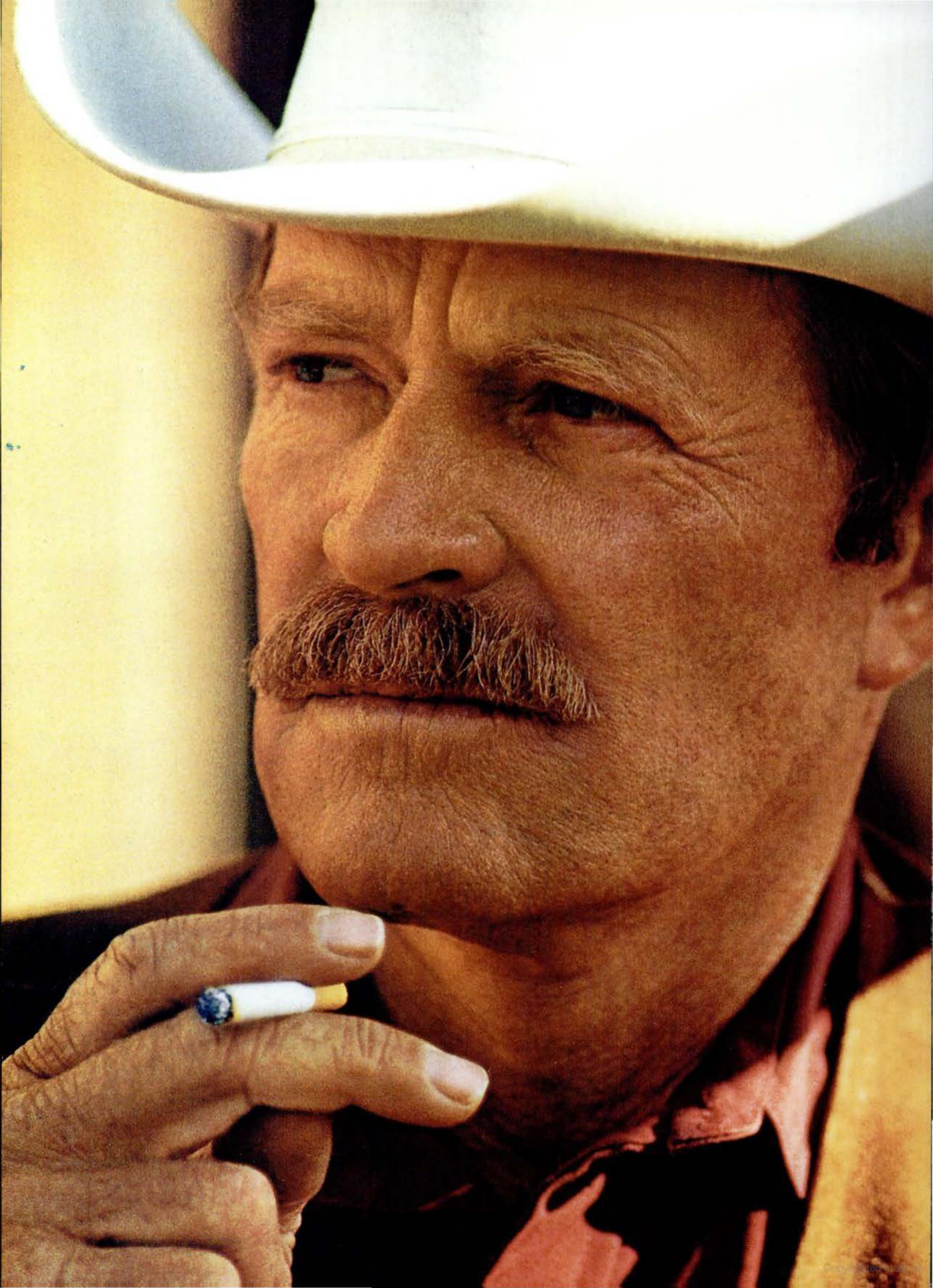

# Come to where the flavor is.

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av. per cigarette, FTC Report Feb.'85

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The WHAT'S NEW magazine
# Popular Science®

**NOVEMBER 1986**
Founded in 1872/Vol. 229, No. 5

## Satellite TV puzzle

With scrambling, it seemed the skies would soon be dark for satellite TV. Now descramblers are available, and the price of "bird watching" is dropping. Satellite TV surely won't die, but some channels may remain forever off limits. **Page 70**

## Halley-lujah!

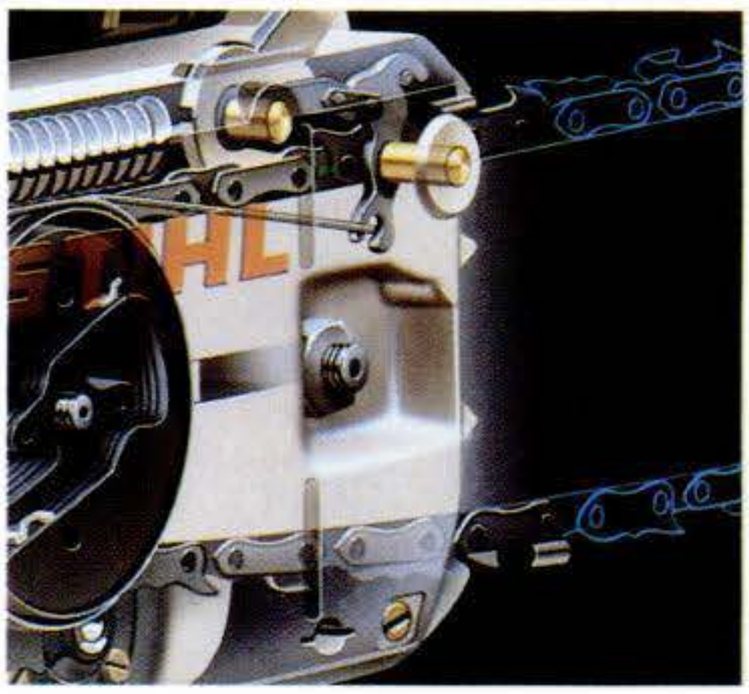
After some 2,200 years of hoopla, astronomers poring over data sent to Earth by a bevy of spacecraft can finally state what Halley's comet is really like. Surprising conclusions: The tumbling comet is jet black and has strange geysers spouting from cracks in its crust. **Page 50**

## Street dancers

Plymouth's hot new compact, Sundance Turbo, promises practicality and pizazz. But can it keep pace with the Chevy Cavalier Z24 and Buick Skyhawk Turbo? Find out in this month's car test. **Page 22**

## Safer chain-sawing

Because of new industry regulations, chain saws are now made with features that make them safer to use. But they're still treacherous tools, and the key to safety remains with the user. Just how safe are chain saws? And how can you avoid becoming an injury statistic? **Page 60**



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# WE JAPANESE HAVE FINALLY DEVELOPED AN ECONOMICAL ALTERNATIVE TO THE AUTOMOBILE.

At a time when Japan's car engineers are acknowledged as being among the best in the world, we'd like to acknowledge some who may be even better.

Isuzu's truck engineers.

For starters, consider price. At $6189,* the P'UP you see here is not only the lowest priced Japanese truck,† it's also priced about $3,000 lower than the average price of a Japanese import car.** Or consider economy. The EPA rates it at 25 MPG City and 31 Highway.†† Two numbers that a number of Japanese economy cars have trouble matching. Or finally, consider practicality. This Isuzu P'UP not only carries three in comfort, it gives you a cargo bed that'll carry practically anything.

So before you rush out and buy a Japanese car, perhaps you should stop for a moment and consider your alternatives.

Starting, of course, with ours.

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*Manufacturer's suggested retail price P.O.E., excluding tax, license, transportation fee, and optional equipt. Price is subject to change. †Based on price 7/1/86. **1986 Kelley New Car Price Manual, 3rd Ed. ††Use estimated EPA figures for comparison. Your mileage may vary. Actual highway mileage will probably be less. CA ests. lower.

THE FIRST CAR BUILDERS OF JAPAN.

# ISUZU

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# Readers Talk Back

Address letters for this column to: Readers Talk Back, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

## Nesting nirvana

The "Sun Valley Supertech" house [Aug.] may be self-tending on the inside, but surely it will be an unending task to maintain the outside. Can't you visualize the myriad bird nests that will be built in all those sheltered nooks and crannies? Our feathered friends will find this a paradise for roosting!

Roland E. Hinrichs, Omaha, Neb.

## Spilling stealth secrets

I just received my copy of your September issue, and as usual the articles are both interesting and informative. But I have a problem with the media's general attitude regarding defense secrets, and your article on stealth systems hit home. While I'm sure interested parties have rather good spy systems, why put it together for them? I for one do not think that is responsible journalism. It's not an easy call between the public's right to know and the need to hold things secret. Maybe a little more of "Do they need to know?" and a little less obvious packaging of this type of interesting data is in order.

Joe Gianagrra, West Cornwall, Conn.

I think you were out of line to print your recent article about stealth aircraft. If we have this capability, it seems darn near treason to publish all the tidbits of information you have gathered. Aren't you concerned with national defense? Is selling magazines so important that you would jeopardize national security?

Rolland Stokes, Acworth, Ga.

Thank you for producing one of the most informative articles on the subject of stealth aircraft that I have yet to read. I do, however, take exception to the statement that "the existence of the stealth program first came to public attention in 1980." In Stephen Rosen's book *Future Facts,* published in 1976, an entry is devoted to "Invisible Planes." The entry lists research firms, describes technical details, and even includes an Air Force quote dealing with stealth hardware testing, evidently prior to 1976.

Charley P. Hale, Albuquerque, N.M.

Your September article regarding stealth technology was illuminating. However, I strongly disagree with the statement that visual contact in air-to-air combat is no longer considered important. Since World War I, visual identification of enemy aircraft has been crucial. Even in the air battles over the Falkland Islands and Lebanon (in 1982), most aerial engagements were brought to a sudden conclusion by short-range AIM-9 Sidewinder missiles or guns at close range. With no foolproof IFF [identification, friend or foe] systems available, even the most carefully planned engagements rapidly degenerate into a chaotic free-for-all. Long-range missiles are handicapped by the need for positive identification, and can be jammed or decoyed. For these reasons, "He who sees first, wins" is as true today as it was in 1917.

Robert Ragsac Jr., Los Gatos, Calif.

## Erstwhile electric cars

Your article on the gasoline/electric sports car that doesn't exist yet [Aug.] has just gone into my thick 26-year-old file of electric-car developments that never hit the market. It includes the Charles Townabout of 1960 and Harry Grepke's "hybrid turbine/electric car" [PS, Sept. '75]. Grepke is quoted as saying that the turbine generator on his car would no longer be needed in 1980. By that time, he said, we would have totally electric cars powered by super-batteries. You would think that if this new hybrid you write about is so promising, the big auto manufacturers would be racing to be first with it on the marketplace. Is it possible that the Big Seven oil companies don't

*Continued*

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want electric cars on the road because they would sell less gasoline?

Norman B. Reed, Norristown, Pa.

How does the gasoline/electric sports car get 100 mpg when in your own article you say the car loses one-third of all the energy put into it. An efficient car like the Citroën 2CV with a small engine only gets about 50 mpg.

Alexander Gladich, Willowbrook, Ill.

*Dan McCosh replies: "The one-third loss referred to in the story was for most current traction motor-generator combinations. Unique Mobility claims about 95-percent efficiency—about the same as current transmissions. Gains mainly come from running the main power-generating motor at a low, constant horsepower; the remainder from regenerative braking: Energy is recovered by using the wheel motors as generators to slow the car."*

## Plenty of push buttons

I've discovered a feature in 1986 General Motors ETR radios that allows three additional stations to be easily selected with the four push buttons provided. This gives the user seven push-button-selected stations on both AM and FM. I've tried it on several different cars and model radios, and it always works. The three additional stations are set or selected by simply pushing adjacent buttons at the same time, as follows. To Set: Tune in a frequency, push the "Set" button, and push station select buttons one and two simultaneously. Repeat using buttons two and three, then three and four. To Select: Simply push adjacent buttons simultaneously. Apparently some smart engineer was frustrated with being stuck with only four buttons. I applaud his ingenuity.

Lewis A. Drake, Belle Mead, N.J.

## Blue glow of our own

In Chernobyl Omens ["Science Newsfront," Aug.], Arthur Fisher states that the burning of nuclear fuel rods with a furious blue glow could not be observed anywhere in the Western world. As a graduate of the nuclear engineering department of Pennsylvania State University, I witnessed this blue glow in their TRIGA experimental reactor on many occasions. Called Cerenkov radiation, this glow is the result of particles moving faster than the speed of light in water. I am sure the university still gives tours of the reactor, and I encourage people who want to learn more about nuclear energy to contact the nuclear engineering department.

Frederick F. Portz, Pittsburgh, Pa.

## What happened to ROVAC?

On at least two occasions in the last five years POPULAR SCIENCE has had articles on the ROVAC air-conditioning system. As I recall, it involves forcing air at high velocity through a decreasingly narrow orifice to remove heat from the air. Do you know if this technology has ever been turned into a salable product?

Lawrence R. Kahn, Newark, Calif.

*V. Elaine Gilmore replies: "ROVAC goes back many years in the pages of PS, as you may know. The final story [PS, Sept. '83] explains that the original concept, an air conditioner that used air as the working fluid, was abandoned and that by that time, Dr. Thomas Edwards (the inventor) was using a refrigerant. He is a brilliant man whose timing was wrong."*

## Male-female problem

I built the sprinkler unit according to Roy Doty's "Wordless Workshop" plan [Aug.], and then ran into trouble. I couldn't find a garden hose with two female ends.

M. Gray, Kamloops, B.C.

*Roy Doty replies: "Assembly of the sprinkler unit is simpler if a male-type connector is used, as in my drawing. But reader Gray is right: To connect a standard hose to my assembly, you'd have to chop the male end off the hose and replace it with the female type I show. Better yet (to keep your hose usable for other purposes), make up a short connector hose with a female fitting on both ends. Such fittings are available at garden stores."*

## Battening-down the blades

In the article "Texas-Sized Eggbeater" [Aug.], you say that a computer controls the blade speed, but you do not mention how it does this. Is it by applying a mechanical brake or stretching the column upward, or something else?

Vincent W. Irle, Akron, Ohio

*Naomi Freundlich replies: "The computer controls a variable-speed motor drive that adjusts the torque of the generator. When the wind picks up and the blades want to spin faster, the drive will increase generator power output, forcing the blades to slow down."* PS

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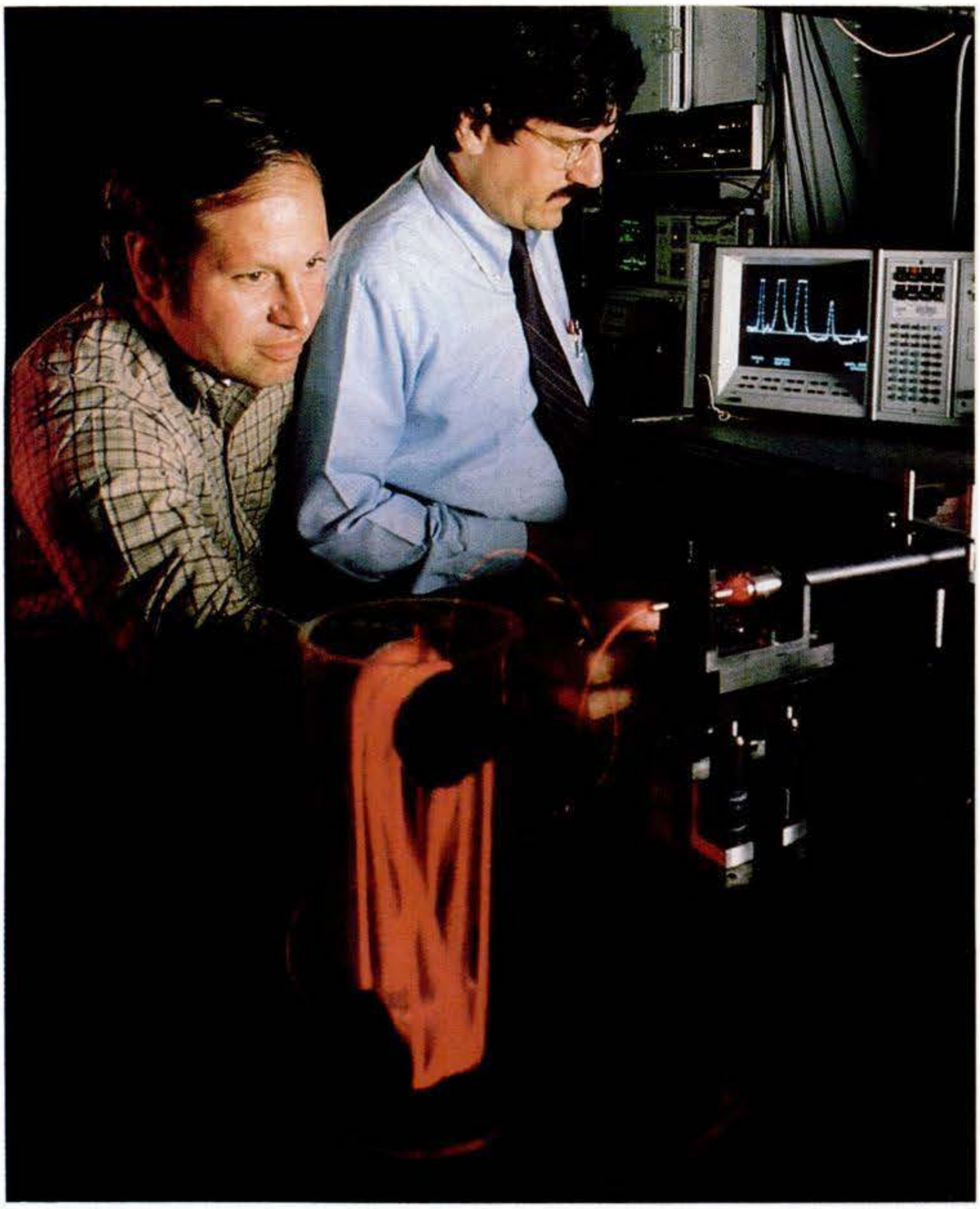
# Science Newsfront

By ARTHUR FISHER



IBM research scientists succeed in damping optical noise in a laser beam.

## Squeezing light

Werner Heisenberg's uncertainty principle is a bedrock of modern quantum physics. It says that the more precisely one knows the position of a particle, the less precisely one can know its momentum, and vice versa. Among the many consequences is that a certain unavoidable amount of quantum noise is associated with all oscillating phenomena such as sound and light waves, ultimately limiting the precision of any measurement or communication system depending on light or sound.

Now physicists at the IBM Almaden Research Center, in San Francisco, report success in reducing such quantum fluctuation by "squeezing" light in an optical fiber over a broad range of frequencies. In the photo above, Robert M. Shelby and Marc D. Levenson are shining a krypton laser beam into an optical fiber coil of fused silica, cooled in liquid helium to within two degrees of absolute zero. The beam is being modulated in such a way as to squeeze, or dampen, the optical noise in the emerging signal. The damping can be clearly seen in the trace on the monitor in the background (read left to right).

The noise reduction is 12 percent below the previously known minimum level, over frequency ranges of 41 to 49 megahertz and 51 to 59 megahertz, the broadest spectrum yet achieved. The results encourage the IBM researchers to believe that the precision of such high-sensitivity devices as laser gyroscopes and gravity-wave detectors may eventually be improved by the light-squeezing technique.

## Deadly grazing

What's wrong with this poor critter? And why is that man in the white coat staring at it so quizzically?

The steer in the photo has crooked calf disease, induced when its pregnant mother ate lupine, a poisonous plant. The man is Richard Keeler, a chemist. Like many of his colleagues at the Agricultural Research Service's Poisonous Plant Research Laboratory at Logan, Utah—the only such facility in the world—he is trying to stem a plague of plant poisonings that costs this nation dearly.

"Each year," says lab director Lynn F. James, "losses related to poisoning affect three to five percent of the cattle, sheep, and horses that graze western ranges, and cost ranchers in those states more than $190 million. The West abounds in shrubs, grasses, and trees that can kill, cripple, cause abortion, and in many other ways interfere with livestock production. And while humans can choose to avoid poisonous plants, animals often cannot."

The task of ARS scientists is to identify specific toxins in such plants, describe the symptoms of poisoning, and develop new methods of reducing livestock losses. One recent finding:

*Continued*

Steer has crooked calf disease, one of many ailments caused by toxic plants.



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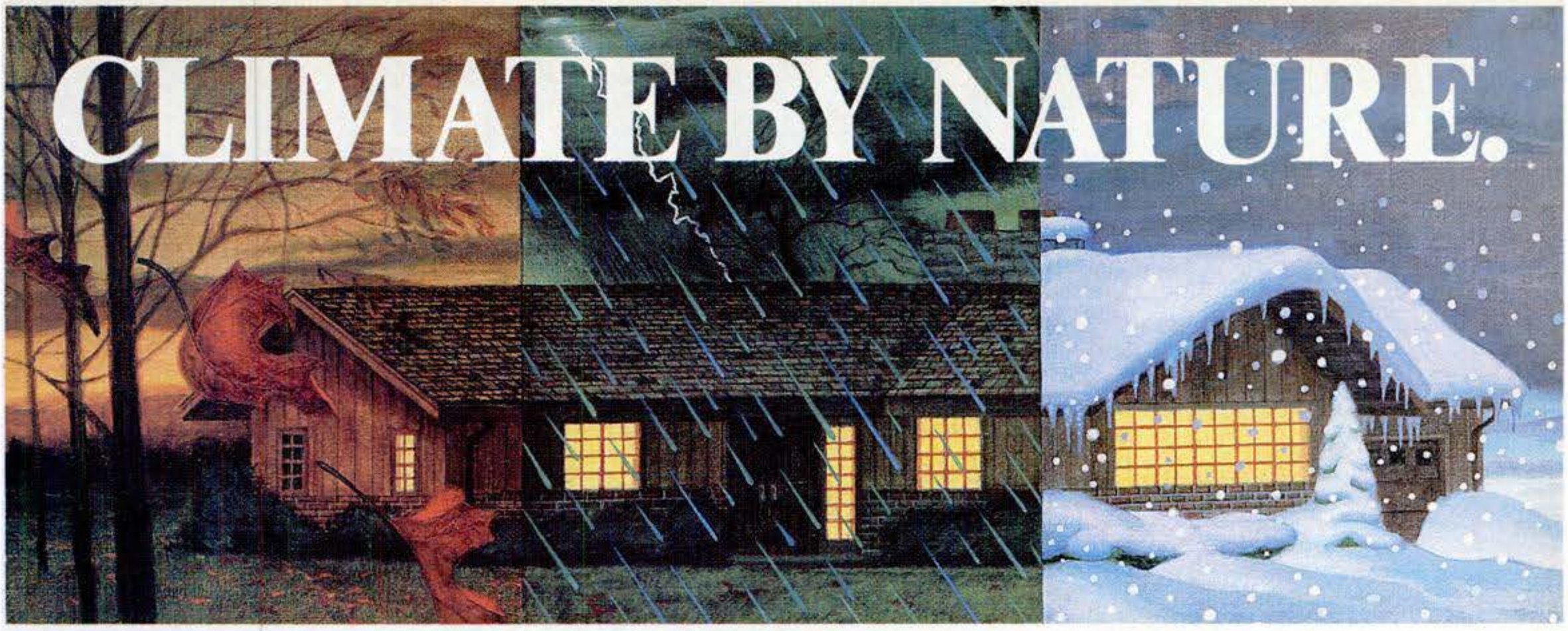


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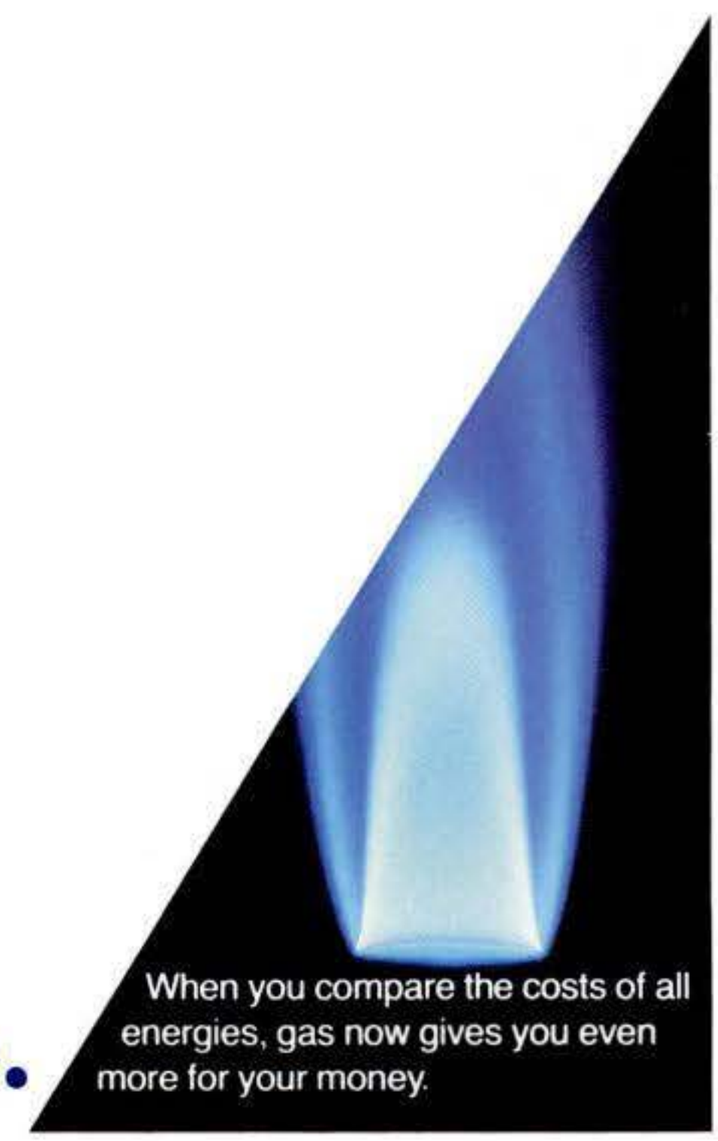

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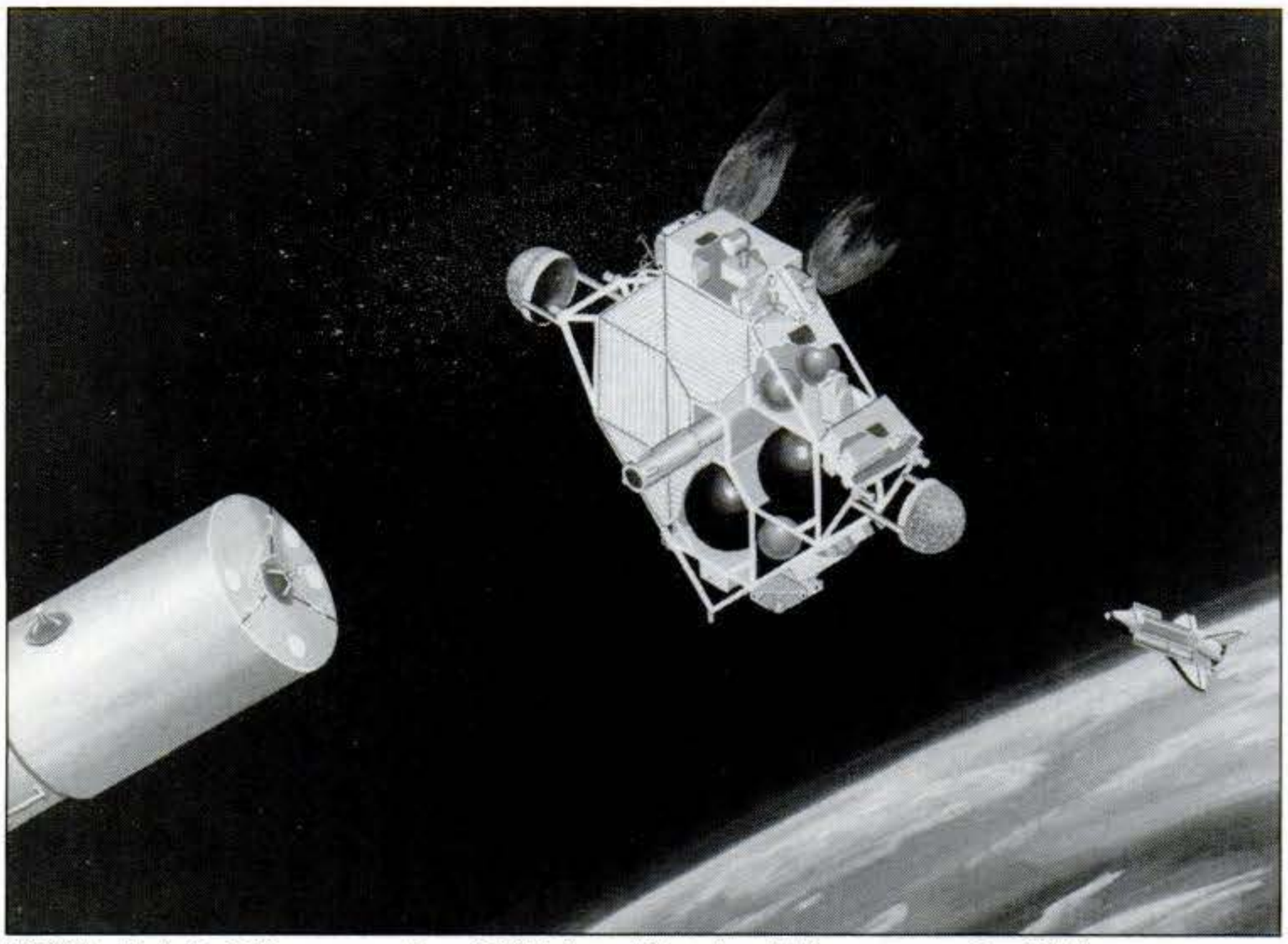

TRW's Orbital Maneuvering Vehicle will extend the space shuttle's range.

ARS chemist William F. Haddon and a team of University of California, Davis, researchers have discovered that a previously unsuspected chemical, trans-4-hydroxy-2-hexenal, may play a key role in producing the toxicity of hundreds of wild plants throughout the world. It is a metabolite formed when certain plant alkaloids encounter enzymes in the liver, and it causes irreversible damage to that organ. Its chemical structure is almost identical to that of a metabolite formed in the livers of animals when exposed to carbon tetrachloride, whose fumes can cause liver malfunction in humans. "This parallel," says Haddon, "may give us some new insights into liver disease."

## Hot stuff in Princeton

A new record has been set at Princeton's tokamak, one of this nation's leading entries in the race to perfect a fusion energy device. Formally known as the Princeton Plasma Physics Laboratory's Tokamak Fusion Test Reactor, or TFTR, the giant machine heated a plasma of deuterium ions to 200 million degrees C, 10 times hotter than the interior of the sun, which is itself fueled by fusion. This temperature is well within the range required for a practical fusion reactor. The achievement was hailed by U.S. Energy Secretary John S. Herrington as "a major milestone in progress toward the development of fusion energy."

In fusion, deuterium or deuterium-tritium ions (heavy isotopes of hydrogen) combine to form helium nuclei; the tiny mass lost in the reaction is converted into energy. To initiate and sustain the reaction, the plasma must not only be heated enough, but must be held together at a high enough density for long enough. (The tokamak design confines the plasma with doughnut-shaped magnetic fields.) Simultaneous achievement of these three conditions has not yet taken place.

## Robot space tug

NASA has entered negotiations with TRW Inc. for a contract to develop the first robotic space vehicle by 1991. Shown in the artist's concept above, it is the Orbital Maneuvering Vehicle (OMV), an unmanned space tug. Its mission: to extend the range of the space shuttle by some 1,500 miles, and eventually to support the proposed U.S. space station, by tugging satellites and other orbiting objects from place to place.

In the drawing, the OMV is approaching a disabled satellite in order to return it to the shuttle, and Earth, for repair. It will deliver such payloads to orbits well beyond the reach of the shuttle, and will also reboost satellites like large observatories as their orbits gradually decay. As envisioned, the disc-shaped OMV will be the same diameter as the cargo bay of the shuttle—15 feet—and about four feet thick.

Self-contained, powered respirator makes for cool heads on hot jobs.

## Breathing space

The man in the picture at the bottom of the page is sporting the world's first totally self-contained powered respirator, according to its manufacturer, England's Pureflo Safety Ltd. It has no external battery packs, wires, or pipes. Designed to provide a clean, cool source of air in hot, dirty environments, it has an internal microswitch that automatically turns on its fan/motor unit as the helmet is pulled over the head. After the neck seal is tightened, air is drawn through the snap-fit filter at the back, past the battery housing at the top, and across the face. Exhausted air exits through a check-valve system at the chin, which prevents any polluted air from being inhaled. The nickel-cadmium battery pack gives eight hours of continuous use.

## A gene for heart disease?

There is preliminary evidence, according to medical researchers at Lawrence Berkeley Laboratory, in California, that a single gene, existing in about 15 percent of people, may carry a tendency toward developing heart disease, by predisposing them to the abnormally high blood lipids associated with diseases of the circulatory system. Dr. Ronald M. Krauss of LBL's Donner Laboratory cautioned that the finding was based on a small sample—17 Mormon families in the San Francisco area. If the result is supported by further research, says Krauss, "we may have identified a relatively common genetic trait that could explain much of the familial clustering of coronary heart disease in the general population." But he adds that "this should not . . . de-emphasize the importance of exercise, diet, drugs, and changes in lifestyle." PS



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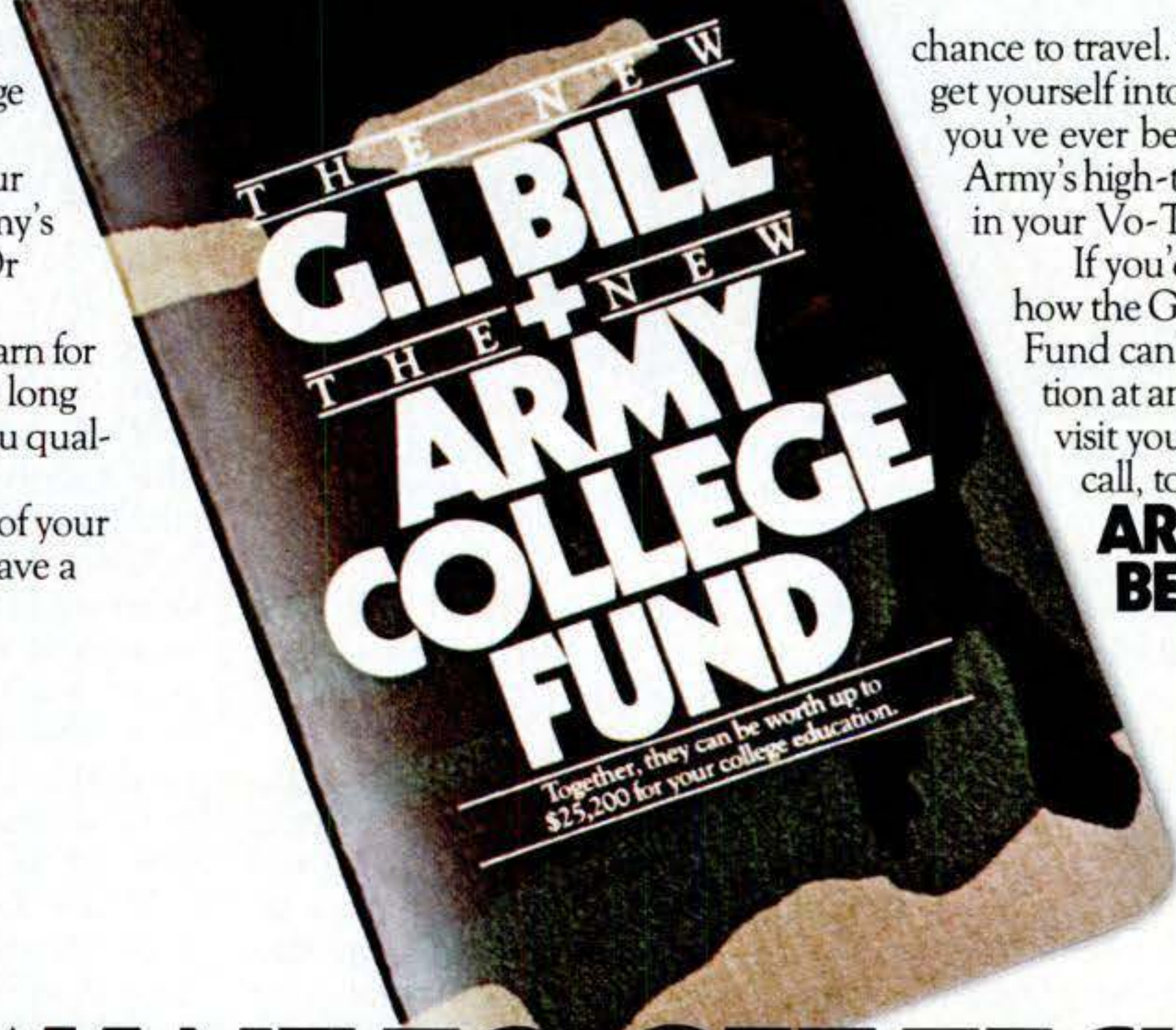


# IF YOU WANT TO GET TECHNICAL IT ISN'T ONLY FOR COLLEGE.

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# Automotive Newsfront

By DAN McCOSH
Detroit Editor

PHOTOS BY JACK KEEBLER

## Faster still

There are now four versions of the four-cylinder Porsche: 924S, 944, 944S, and 944 Turbo. Think of them as fast, faster, faster still, and fastest.

Although Porsche claims a 142-mph top speed for the latest, the 944S, we saw the needle nudge past that on a downhill stretch of the no-speed-limit Autobahn in Germany. There might have been a tad more speed there, but there was a big Citroën poking along at a mere 90 mph in the fast lane, so the four-wheel discs were called upon to drop the Porsche to a more leisurely pace.

**Porsche 944S churns out 190 hp from its 2.5-liter four. Air bags for driver and passenger are offered.**

The force behind this incredible performance, and the major difference between the 944 and new 944S, is the latter's 190-horsepower 16-valve 2.5-liter engine. (That's 40 hp more than is produced by the eight-valve engine in the 924S and 944.) This engine is bolted to an exquisitely smooth five-speed manual transmission. Although it won't be available initially, Porsche promises an automatic in the near future.

Selling such a car in a country where the speed limit is 55 mph may seem illogical. But Porsche insists there are reasons to consider the 944S both safe and sane.

First, the shape of the four-valve combustion chamber and its central spark plug promote equal flame travel in all directions. Combined with a sophisticated knock-control system, this allows a 10.9:1 compression ratio for high torque and low fuel consumption.

Also, an optional four-wheel anti-lock braking system is available in the 944S. Porsche engineers say the unit is similar in design and function to that fitted to the V8-powered 928S.

And finally, Porsche has developed a completely new air-bag system for the car that protects not only the driver, but the passenger as well. Optional in the 944 and 944S, it comes as standard equipment in the 944 Turbo.

Like other front-engine Porsches, the ride of the 944S is firm but not harsh. An enthusiast driver might even describe it as supple. Apparently, Porsche engineers have provided enough wheel travel and tuned shock damping to allow the wheels to step in and out of bumps without having the car skate through rough corners.

Of course, all of this performance, poise, status, and safety has its price —$28,250, to be precise.

## Electric upshifts

It now appears that Isuzu, General Motors' affiliate in Japan, will beat Chrysler to market with an electromechanical automatic transmission. Both companies have been working on automatics that use computers to precisely control gear changes, rather than the hydraulics currently used.

Isuzu's design is really a robot-controlled manual, with the clutch and shifter actuated by hydraulic rams. Chrysler reportedly is working on a system in which electric solenoids control planetary gears.

The goal of both programs is to optimize the efficiency of the automatic transmission—a tough proposition because current automatics are highly reliable and efficient.

## Three from Toyota

What do you do with a family sedan that sells so well that dealers can't keep it in stock, and also winds up near the top of every consumer satisfaction survey? If you're Toyota, and the sedan is the Camry, you completely redesign it, that's what.

Gone is the light, angular styling of the current Camry. In its place is a rounded, slightly heavy body that could easily be mistaken for a Cressida. The looks won't win any beauty contests, but what's under the hood should be a sobering sight for other car makers.

While Detroit tinkers with prototype 16-valve engines, Toyota is putting them into the hands of mom and pop. The Camry's two-liter four has a compact aluminum head with four valves per cylinder. A toothed belt drives the intake cam, which in turn drives the exhaust cam via spur gears. By using a spring-loaded sub gear to take up the lash, Toyota has made the gear train almost totally silent. (We

*Continued*



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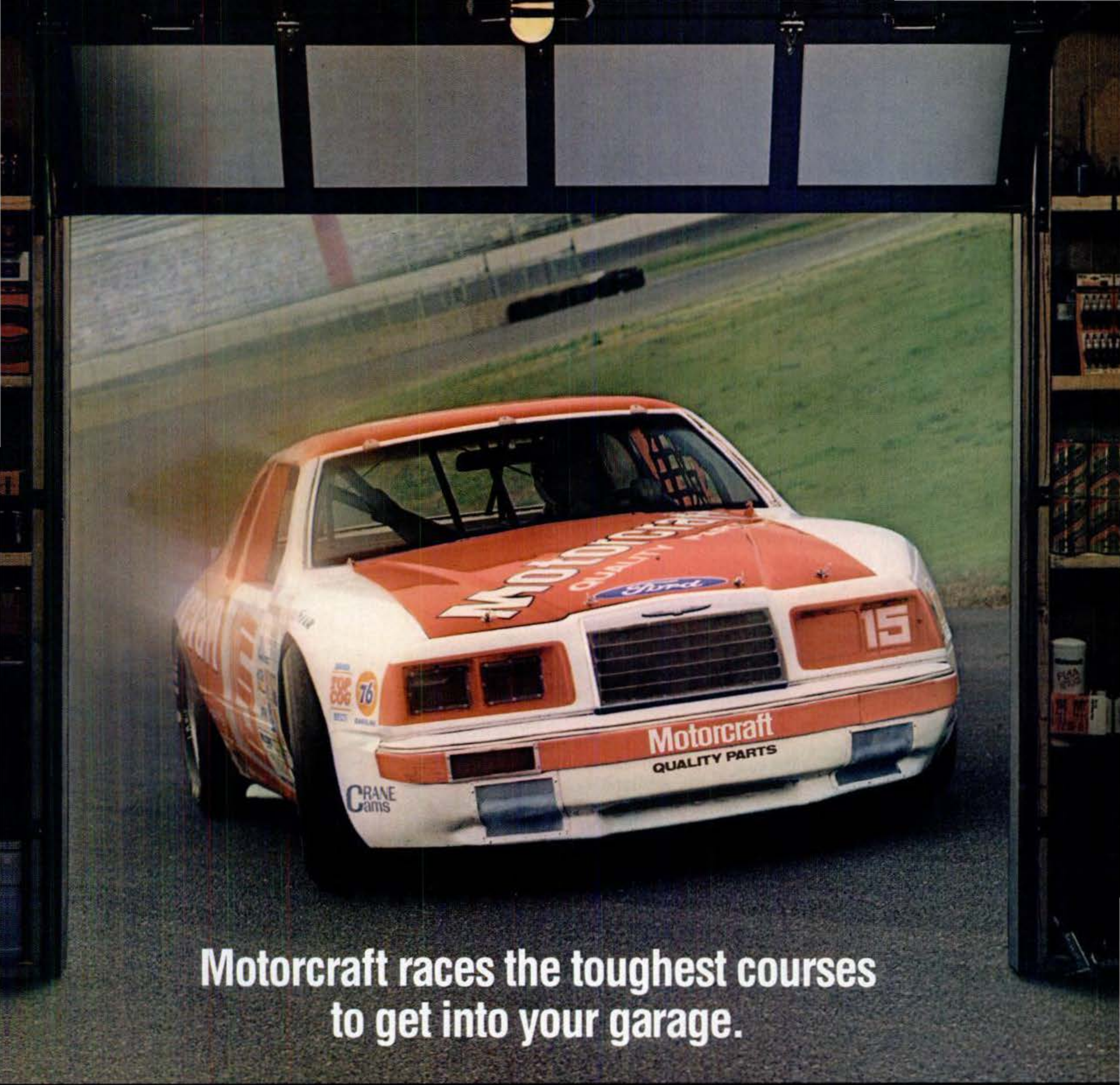


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# Motorcraft from Ford

*EXCEEDS THE NEED*

Buckle up—together we can save lives.

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put an ear to the cam cover, and could hear nothing but the gentle clatter of lifters.)

Teamed with fuel injection that uses long, tuned intake runners, the new head gives the Camry V6-like torque. The same engine also goes into the ST and GT versions of the Celica, making a great car even better.

Toyota will build Camrys at its Scott County, Ky., plant, starting in mid-1988. This will pour 200,000 more Camrys per year right into the heart of the family sedan market, and could pose a serious threat to the domestic Big Three.

For those seeking a bargain, Toyota also is building a brand new Tercel. Three valves per cylinder (two intakes, one exhaust) and a constant-velocity carburetor (similar to the cantankerous SU) help the 218-pound aluminum engine pump out 78 horsepower. The rest of the car's as sweet as the engine, drawing nothing but rave reviews from those who drove it at the Toyota new-model preview.

Finally, a turbocharged version of the Supra offers the kind of mid-range torque normally found only in a large V8. Anti-lock brakes, built by Toyota under license from Bosch, help slow the big coupe from its 140-mph top speed.

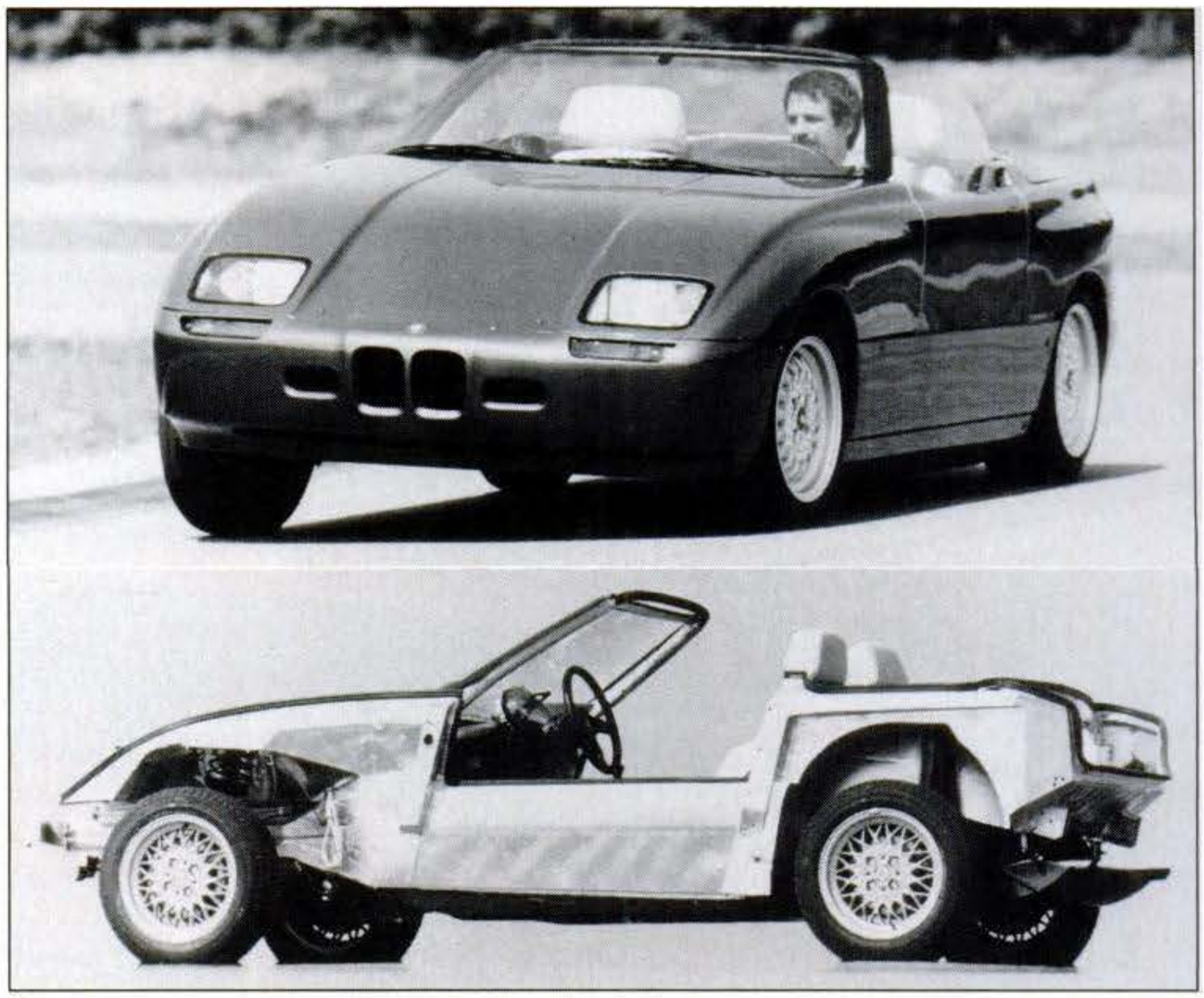
## Bavarian delight

BMW's Z1 prototype may signal a sports-car revival for the Bavarian auto maker. The two-seater is based on 325i components, but here the 171-horsepower engine, five-speed gearbox, and rear differential are tied solidly together by a massive aluminum torque tube, forming the backbone of the car. Additional strength comes from a load-bearing structure of galvanized steel, while plastic skin panels provide a 0.32 drag coefficient. For safety, a rollover bar is integrated into the windshield frame.

Independent rear suspension of the Z1 uses new coil-sprung semi-trailing arms currently under development for BMW's revised 3-series car. Weight of the roadster is just 2,205 pounds, and 0-to-60-mph times of seven seconds are claimed. When can you buy one? Production could be just a few years away.

## Time to retire?

New suspension technologies under development by auto makers are already having an impact on tire design. Ford's new Thunderbird Turbo coupe, which for 1987 is fitted with electronically controlled shock absorbers that stiffen in corners, has engineers at Michelin scrambling to design a special tire adapted to the shocks' handling capability.



**German roadster: BMW's Z1 prototype uses a backbone-type frame and 325i engine and drive train. It may be the first step toward a BMW sports car.**

The new turbo T'Bird will be shod with Goodyear Gatorback tires as standard equipment, and the jury is still out on whether a special design from other tire makers would sell well enough to justify the effort. Regardless, variable-rate shocks are just one of the new technologies that will affect future tire design.

Car makers' interest in rear-wheel steering, four-wheel drive, and active suspension all mean new approaches to tires. "Some of the work now done by the tires could be done by these suspension systems," says a Michelin engineer. For instance, one result could be more ride comfort with no sacrifice in handling because softer sidewalls could be introduced without giving up quick response to small steering inputs.

## Rear-drive redux

Not long ago, it seemed that big rear-wheel-drive luxury cars would go the way of the dinosaur. Now it looks like they'll roll on for a decade more. Reports are that General Motors will build full-size rear-drive sedans and wagons well into the 1990s, allowing Buick, Cadillac, Chevrolet, and Oldsmobile to keep models that still sell extremely well.

Chrysler, meanwhile, wants American Motors Corp. to build its rear-drive Fifth Avenue, Dodge Diplomat, and Plymouth Gran Fury models in unused space at the AMC plant in Kenosha, Wis. Such an agreement, if finalized, would extend the life of these models a few years. The St. Louis plant that currently builds rear-drive Chryslers is being converted to make more mini-vans.

## Rugged rotary

It's easy to forget that durability was once considered a problem with rotary engines. Now a Mazda rotary with twin turbochargers is being readied for the Bonneville salt flats. Producing some 500 horsepower at 8,000 rpm, the engine will be used in an attempt to break a class record of 201 mph.

## News briefs

- Care to guess which Chevrolet appeals to the wealthiest buyers? Corvette? Caprice Classic? Try the Suburban. Chevy marketers say the giant truck-based wagon sells extremely well in Texas, where it's "a very similar vehicle to a Mercedes—very expensive, very upscale." Take that, Mr. Daimler and Mr. Benz. PS

*Contributors: Jack Keebler, Tom Wilkinson (New York); David Scott (Europe)*



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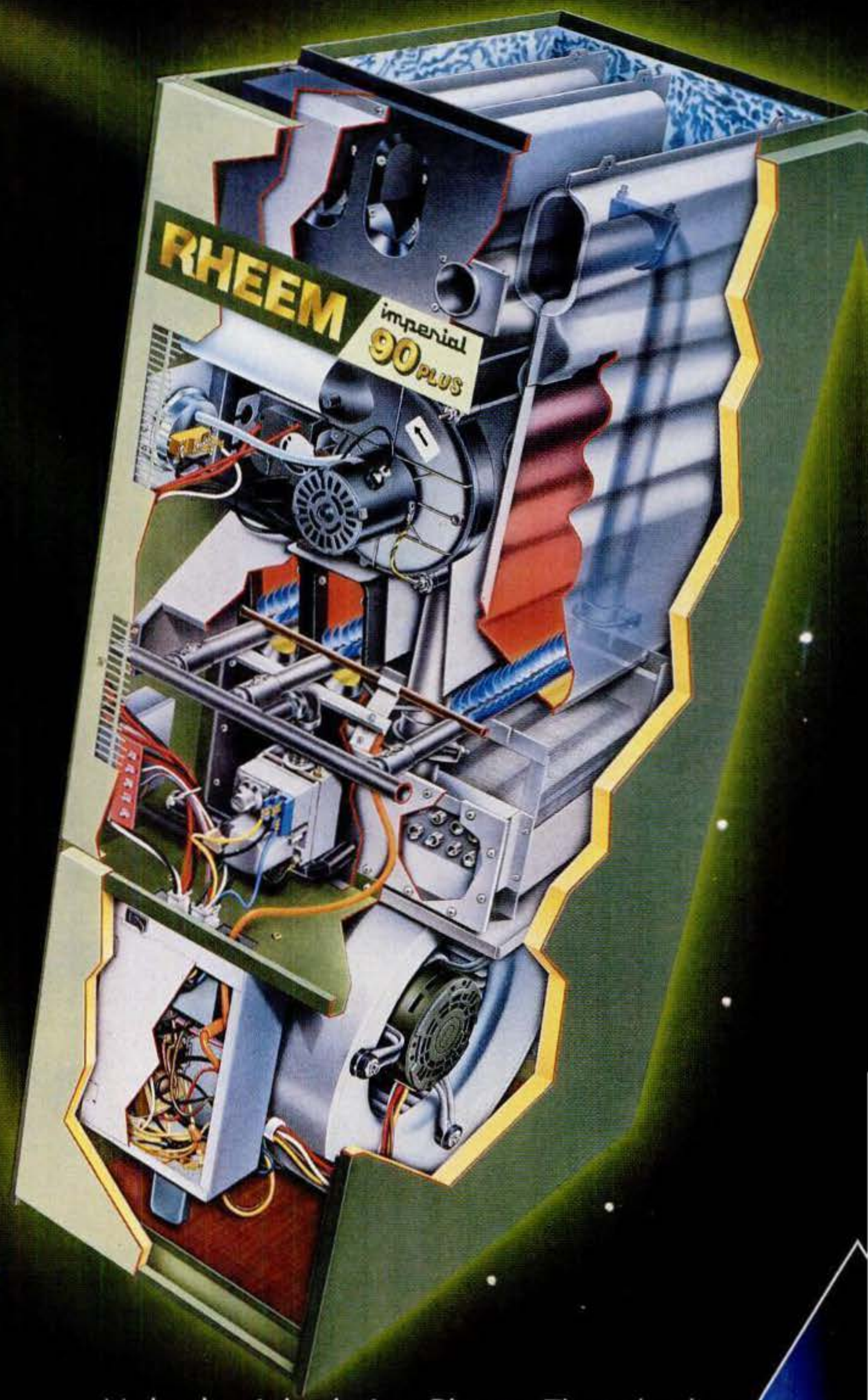


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# New Apple crop:

## *Mac-like IIGS*

PHOTO BY MARC GELLER

It's compatible with all Apple IIs, but the new GS model is faster, used like a Mac, and ready for future 16-bit software.

**By JIM SCHEFTER**

A slide show of color photographs, cartoons, and drawings cycles on the screen in front of me. The pictures look as good as commercial television. But I'm not watching TV. I'm at Apple's Cupertino headquarters, seeing the first demonstration of its new top-of-the-line computer: the Apple IIGS (graphics and sound).

The GS works like a Mac—pull-down menus, on-screen icons, mouse control, and high-speed processing power—but it can use all Apple II programs, and it will accept future 16-bit software. How does it do all that?

Tom Virden, GS marketing manager, opened the top to show me the machine's logic board. "The GS uses surface-mount technology that puts a lot of chips into one package," he explained. "On this board, an entire Apple IIe is inside one package 1.25 inches square."

It's the rest of the board that makes the GS so powerful—and fast. Computational speed is 2.6 times faster than the IIe. Virden pointed to a second microprocessor. "This handles the new 16-bit software now being developed," he said. I also saw seven expansion connectors, normal for a IIe, and an eighth socket dedicated to memory expansion. "You can fill that slot immediately to give the GS a megabyte of memory," said Virden, "and other boards being developed could expand memory to eight megabytes."

That could be expensive. A basic GS costs $995; a GS with color monitor and two disk drives (3.5 or 5.25 in.) is $2,500; and a fully loaded eight-megabyte system is a whopping $4,000.

I tried the GS. Using the mouse to pull down and open a menu, I was confronted with a control panel—icons of dial settings that you can change, and options from which you can choose.

By clicking the mouse button I could choose among seven display modes—including both 40- and 80-column text—and a variety of graphics displays from low to super-high resolution. Like the earlier model IIs, the 40-column text mode creates dot-matrix characters that look old-fashioned. The display improved significantly in the 80-column mode, but it lacked the solid smoothness of the Mac, and it didn't approach the TV-like quality I'd seen in the graphics mode. Of course, the GS does beat the Mac in one area: Up to 16 colors can be displayed from a pallette of 96.

The panel also let me control the volume and tone created by the new GS sound synthesizer, a chip that can play 15 separate voices or instruments simultaneously. Quality? The sound from a music program I tried was the best I've heard from any computer.

For the moment, the success of GS may rest on its ability to use present Apple II software. Its future will rely on hardware and software to come. Says Virden: "It was an incredible technical challenge to develop a machine that is compatible with Apple IIs but offers true sixteen-bit power." PS



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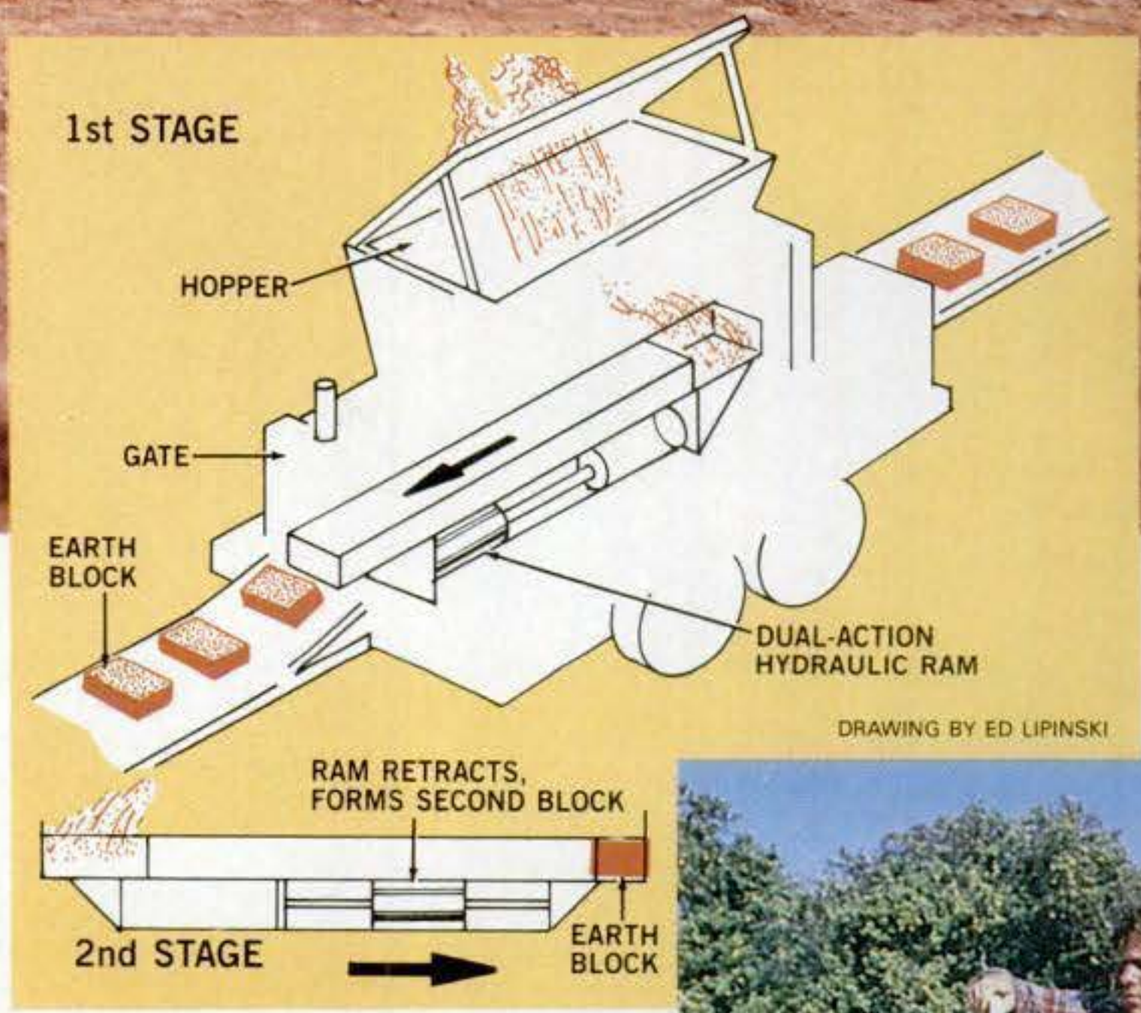

**Two-way operation of Terra Block machine keeps workers unloading rammed-earth blocks from both ends. During first stage, soil is compressed at up to 440,000 lbs./sq. ft. In second stage, as the ram retracts, a second block forms. Walls may be dry-stacked or bonded with mortar.**

**By JOHN FREE**

ORLANDO, FLA.

"Watch out, you'll miss it," shouts Michael Gross, president of Terra Block Worldwide, above the roar of a 50-hp diesel engine. For an instant, I've glanced up from a knee-level conveyor ramp on a machine that makes earthen blocks. When I look back down, a 30-pound building block formed from reddish, sandy local soil has appeared—as if by magic—on the ramp. Moments later, another 12-by-10-by-4-inch block slides onto a second ramp.

Such dazzling speed—some 600 blocks an hour—sets Terra Block's earth-block machine apart from others on the market. What's really attracting builders, especially from Third World countries, however, is the machine's simplicity and dirt-cheap product: Transport a machine to a building site, shovel in soil, and start the engine. A high-pressure hydraulic ram squeezes out the ready-to-use blocks. Construction is simple, too: After walls are stacked, an optional sealant and stucco coating can be applied.

Robert Gross, a former NASA engineer who designed and patented the machine, says an hour's production requires about ¾ gallon of diesel fuel. "That's less than three-tenths of a penny in direct fuel costs per block, or twenty times more energy savings than the best contemporary construction materials," says Robert Gross.

Is any soil suitable for blocks? The designer's son, Michael, ushers me into a small showroom made with earth blocks at Terra Block (175 Drennen Rd., Orlando, Fla. 32806). "Florida has the worst soil condition," he says, tapping the earth-block walls. "Our soil is ninety-two percent sand." Sandy soils work fine but require more pressure, while clay soils need less. All blocks are formed in ⅕ second, although blocks of certain soils slide out faster. "In Africa, where they've got the best soil for blocks I've ever seen, we had a machine making fourteen of them per minute," says Michael Gross. "But we haven't found any soil yet that won't work." PS



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# PRIDE IS BACK

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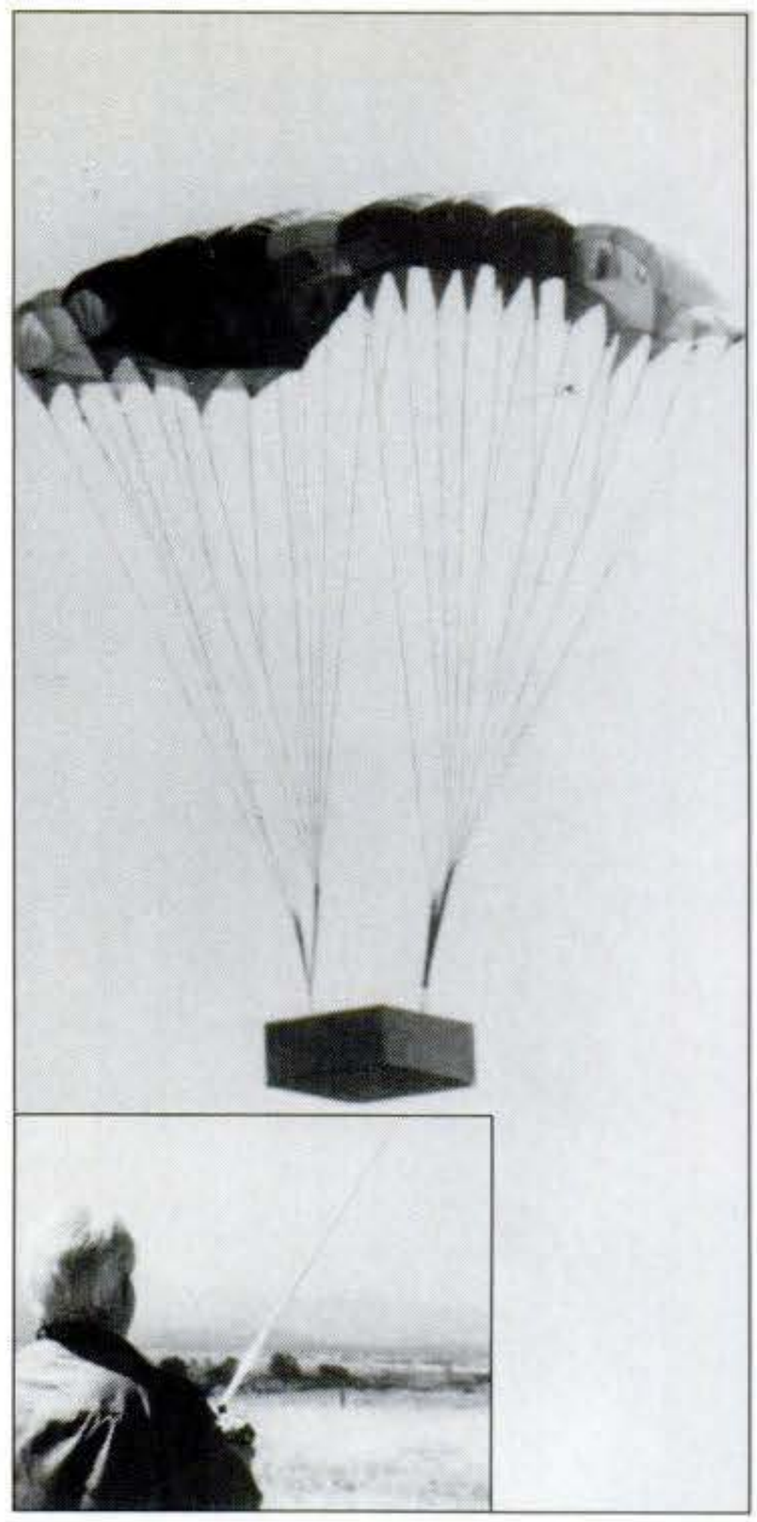
# Radio-controlled parafoils



Eddies of superheated air swirl up from the raging forest fire. They become lethal riptides to the cargo plane carrying life-support and firefighting gear toward waiting firefighters on the ground. The plane can't get too close, so while yet miles from the target, it drops its payload. A parafoil unfurls, and the load is guided via remote control to a pinpoint landing.

Parafoils—those rectangular parachutes used by sky divers for precision maneuvers and landings—are now being tested by Lockheed Missiles and Space Co. (1111 Lockheed Way, Sunnyvale, Calif. 94089) for unmanned work. Guided by radio remote control from the ground or an aircraft, the experimental parafoil can deliver on-target payloads from a drop point up to 20 miles away.

The guidance electronics is carried in a cargo box suspended beneath the parafoil. The 12-volt, battery-powered radio receiver is the same as used in radio-controlled airplanes. It uses commands from the ground transmitter to control three on-board motors. The motors, attached to the parafoil's control lines, tug at the lines to move the shrouds and change direction—just as a parachutist does.

Lockheed engineers see the system being used not only for air-dropping equipment to firefighters but also for dropping rescue gear to survivors at sea. And the military is interested in controllable parafoils for resupplying ground troops without exposing aircraft to small-arms fire.

At present the tests are performed from only a few thousand feet (right). The cargo box is carried aloft by a helicopter, then released and the parafoil deployed. Its descent is controlled from the ground (inset).—*Bill Siuru*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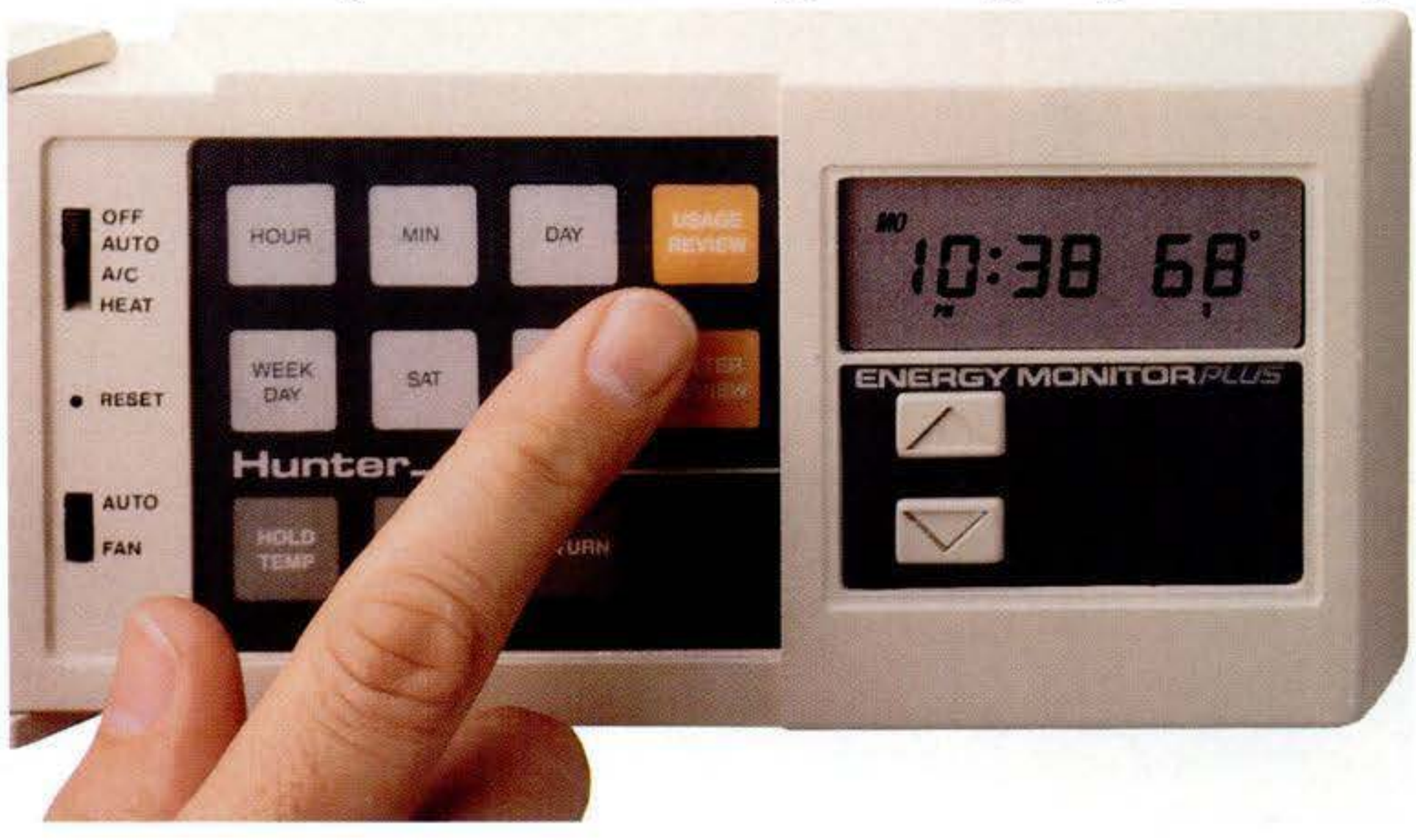


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**The following introduces one of the most fully tested and credentialed gas saving, friction reducing engine treatments ever to reach the market!**

**WHAT IS POLY?** "Poly" is short for polytetrafluoroethylene (TFE). It is the slipperiest substance known to man **(1981 Guiness Book of World Records, p. 188).** The PetroLon Corporation, makers of Slick 50, has invented a way to permanently bind this slippery chemical to your engine with one treatment. All you do is add one quart of Slick 50 to your oil during oil and filter change. By reducing engine friction, Slick 50 increases gas mileage and horsepower and reduces engine operating temperature thus causing your oil and engine to last longer. Just as important, it reduces metal wear, defraying costly overhauls.

**HOW DO I KNOW THIS ISN'T A FRAUD?** Slick 50 has some very impressive credentials. The **"Consumers Digest"** magazine (March/April 1982, p. 35) states "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about two or three miles per gallon.... Slick 50 does exactly what Petrolon claims it does." Researchers at a **nationally respected research laboratory**, after applying a powerful ultrasonic cleaning process to a Slick 50 treated engine part, were surprised at its permanence. They stated, "We actually expected the PetroLon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

The **Federal Aviation Administration** has fully accepted a similar product- Slick 50 Aircraft Treatment (F.A.R. #33.49). An FAA test simulating 1400 hours of engine use (equivalent to about 70,000 miles on a car) showed almost zero engine wear!

**"Dune Buggies and Hot VW's"** magazine, April 1983, p. 70-71, records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work and that it does reduce engine wear!.... for the price of one treatment when compared to engine rebuild, we feel you'd be money ahead using Slick 50."

A test done at the **San Diego State University** revealed that, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university." The **Space Shuttle Columbia** uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps the most dramatic of all is a

torture-test overseen by the **Automotive Services Council for Pennsylvania** and shown on television station WTVE. Three cars with between 75,000 and 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle and the cars were driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage. There are many more tests available. If you are still skeptical, send $2.00 to defray printing and postage costs and we will send you additional, more detailed, test information, etc.

**HOW DO YOU TREAT AN ENGINE?** Very simply. Just before oil and filter change, add engine flush (sent free with each order) to clean out your engine. Let your engine idle for 5 minutes. Then drain your oil, change filter and add the proper amount of oil less one quart. Add one quart Slick 50, drive for 30 minutes, and leave it in the crankcase for 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burnished into the pores of the metal. Once impregnated it is permanent, so **you do it only once**, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8 cylinder gasoline and diesel engines.

**WILL IT WORK WITH MOST OIL?** Yes, Slick 50 will work with all petroleum based oils and all synthetics compatable with petroleum based oils.

**WHAT ARE THE BENEFITS OF SLICK 50?** Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, etc. By reducing friction, Slick 50 does all of the following: it **increases gas mileage**. It **increases horsepower** -- small economy cars and large RV's really need this. It makes for **easier starting** (important in cold weather). It **reduces operating temperatures**, thus increasing the lubrication and life of your oil and your engine. Since lubricating lead is being removed from gas and unleaded gas is poor in lubricating qualities, the **extra lubrication of Slick 50 on valve stems and guides is very valuable**. Last, but not least, the drastic reduction in engine wear **defrays or eliminates costly overhauls** which can save you over $1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the wear on a car can be caused by this lubrication starvation. You receive all of these benefits for **less than the cost of two tanks of gas** ($39.95).

**WILL SLICK 50 HARM MY ENGINE OR AFFECT MY WARRANTY?** No! Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturers engine warranty requirements. In addition, this oil carries an API (American Petroleum Institute) service classification SF-CC-CD.

**DEALERSHIPS ARE AVAILABLE.**

**OTHER SLICK 50 PRODUCTS** available are Gear Treatment (manual transmission, etc.), 2-Cycle Engine Treatment, Grease, Ultra 9 Oil, Fuel Conditioner, and Fabric Protector. Free information is sent upon request.

**EASY TOLL FREE NUMBER.** Since Slick 50 is **"too too Slick"** for engine friction, our toll free number is 1-800-22-SLICK (that is, 1-800-227-5425).

**Free engine flush sent with each order. Free shipping with orders of 2 or more.**

**For purchase or further information call toll free 1-800-22-SLICK, (in Colorado, call 1-303-667-1715) or send to: FORT MORGAN SLICK 50, 407 Del Rio Road, Berthoud, Colorado 80513.**

PS11

☐ I enclose $39.95+$4.00 shipping & hand.
☐ I want 2 or more (free shipping & hand.)
☐ Check ☐ C.O.D. ☐ Visa/MC

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(Give street address for U.P.S. delivery)

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State _____ Zip ____

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Sundance, Plymouth's hot new turbocharged compact, promises both practicality and pizazz. But can it keep the pace with two seasoned performers, the Chevrolet Cavalier Z24 and Buick Skyhawk Turbo? To find out, POPULAR SCIENCE tests them . . .

**By TOM WILKINSON**

# STREET DANCERS

Who buys these cars? That question popped into mind the first time I saw the cars in this test group. It wasn't meant to be harsh; it was just a logical thing to ask. After all, PS had just finished testing two of the smoothest, most refined sport coupes around, the Toyota Celica and Acura Integra. And it didn't take more than five minutes with the three domestics to realize that they weren't going to be the polished performers their Japanese rivals were.

But once I recovered from the culture shock, I found this trio starting to grow on me. Each has a slightly brash, broad-shouldered personality that is distinctly American. And if you're willing to overlook a few rough edges, each provides a reasonable measure of practicality and driving fun. And one car in the group appears to be the hands-down choice for those looking for easy serviceability.

## Mass appeal

Slide into the front seat of the Sundance and look around—you'll swear you've been there a thousand times before. That's no surprise. The Sundance and its twin, the Dodge Shadow, share engines, transmissions, suspension parts, floor-pan stampings, and hundreds of smaller bits and pieces with Chrysler's other front-drive sedans, sports cars, and mini-vans.

Familiar, too, are the Cavalier and Skyhawk. That's probably because they are both members of General Motors' J-car family. Some 700,000 J's were sold last year in the U.S. alone, outfitted as everything from stripped Cavaliers for rental fleets to loaded Cimarrons for the country-club set.

Only in America would a company mass-produce three-quarters of a million nearly identical cars, then try to tailor each to the tastes of every cowboy, computer programmer, librarian, and street racer. This allows buyers freedom of expression at a reasonable price, but the result is cars that feel as if their parts were never quite made to work together.

[Continued on page 28]

*Turn page for test results and specs*



PHOTO BY TOM WILKINSON

**The Plymouth Sundance Turbo (above right) is Chrysler's newest entry in the sporty-sedan market. There it squares off against the Chevrolet Cavalier Z24 (far right), with its 120-hp fuel-injection V6, and Buick's Skyhawk Turbo (above), with a powerful 1.8-liter four.**

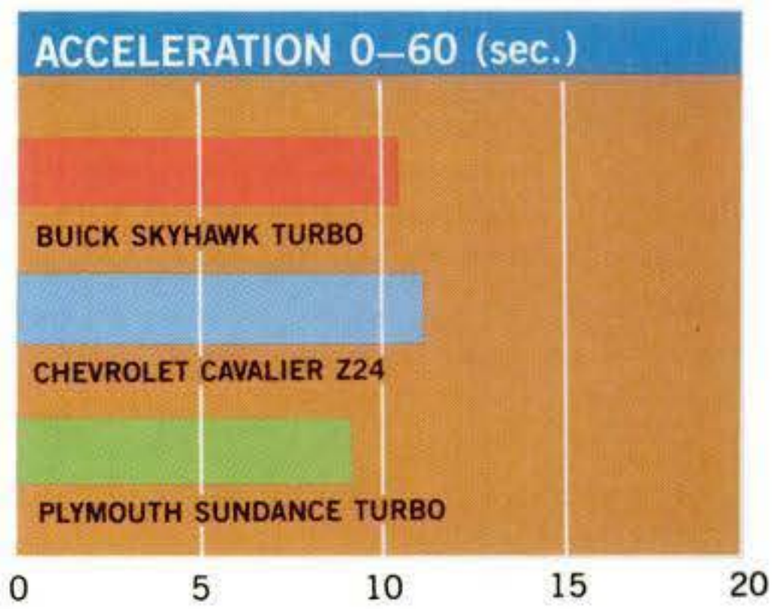




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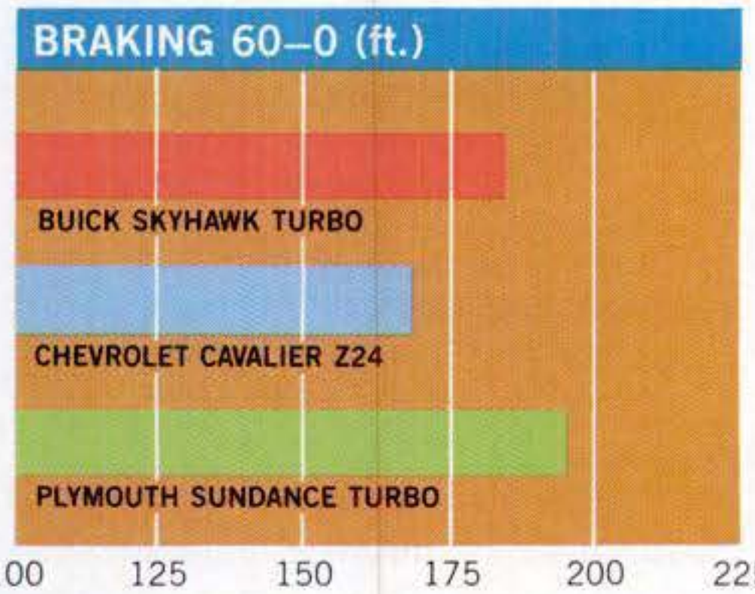
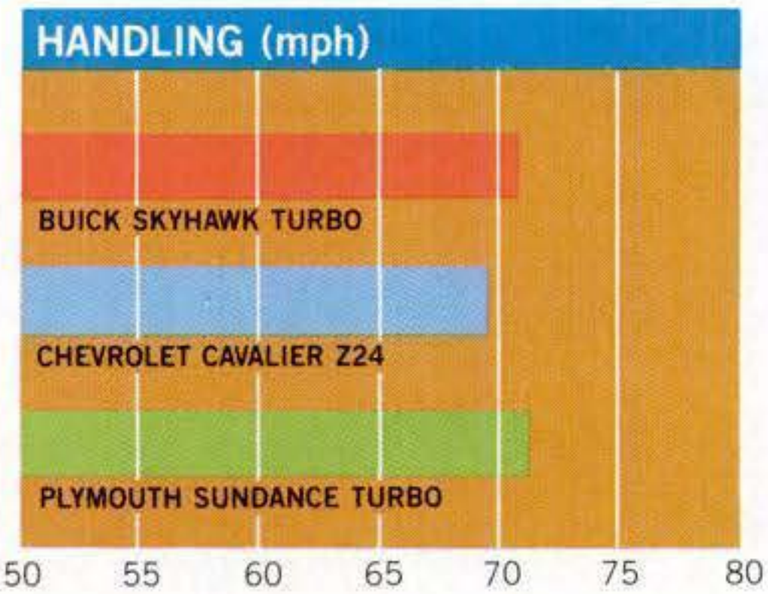
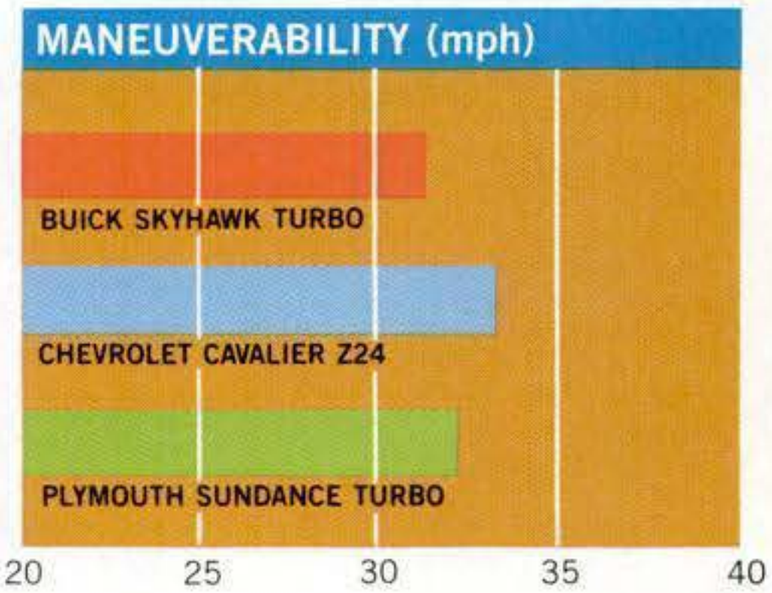
PHOTO BY JOHN NEITZEL



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## POPULAR SCIENCE TEST RESULTS

| TEST RESULTS | Buick Skyhawk Turbo | Chevrolet Cavalier Z24 | Plymouth Sundance Turbo |
|---|---|---|---|
| **Acceleration (sec.)** | | | |
| 0–30 mph | 3.3 | 3.4 | 2.9 |
| 0–60 mph | 10.5 | 11.2 | 9.2 |
| **Brake test, 60–0 mph** | | | |
| Stopping distance (ft.) | 185 | 168 | 196 |
| **Pedal pressure, cold (lbs.)** | | | |
| (0.5-G stop) | 11 | 11 | 10 |
| **Pedal pressure, hot (lbs.)** | | | |
| (0.5-G stop) | 20 | 16 | 12 |
| **Handling test (mph)** | 70.7 | 69.8 | 71.3 |
| **Maneuverability test (mph)** | 31.5 | 33.4 | 32.3 |
| **Interior noise (dBA)** | | | |
| At idle | 58 | 54 | 55 |
| At 60 mph | 69 | 69 | 67 |
| **EPA FUEL MILEAGE (mpg)** | | | |
| Highway | 27 | 26 | 29 |
| City | 20 | 19 | 20 |

## Dimensions and specs

| | | | |
|---|---|---|---|
| **DIMENSIONS (inches)** | | | |
| Wheelbase | 101.2 | 101.2 | 97.0 |
| Overall length | 175.3 | 174.3 | 171.7 |
| Overall width | 65.0 | 66.3 | 67.3 |
| Overall height | 54.0 | 52.1 | 52.7 |
| **SPECIFICATIONS (as tested)** | | | |
| Engine type | In-line turbo 4 | V6 | In-line turbo 4 |
| Displacement (cu. in./liters) | 110/1.8 | 173/2.8 | 135/2.2 |
| Compression ratio | 8.0:1 | 8.5:1 | 8.1:1 |
| Induction | EFI | EFI | EFI |
| Net horsepower @ rpm | 150 @ 5,600 | 120 @ 4,800 | 146 @ 5,200 |
| Net torque (ft.-lbs.) @ rpm | 150 @ 2,800 | 155 @ 3,600 | 170 @ 3,600 |
| Transmission | 3-speed automatic | 4-speed manual | 5-speed manual |
| Final drive ratio | 3.33:1 | 3.65:1 | 2.78:1 |
| Steering | Power, rack-and-pinion | Power, rack-and-pinion | Power, rack-and-pinion |
| Turn diameter (ft.) | 34.7 | 34.7 | 33.9 |
| Front suspension | MacPherson strut with coil springs | MacPherson strut with coil springs | Iso-strut with coil springs and gas shocks |
| Rear suspension | Trailing axle with coil springs | Trailing axle with coil springs | Trailing arm with coil springs |
| Brakes | Disc-drum | Disc-drum | Disc-drum |
| Curb weight (lbs.) | 2,359 | 2,519 | 2,494 |
| F/R weight distribution (%) | 64/36 | 49/51 | 60/40 |
| Fuel tank (gal.) | 13.6 | 13.6 | 14.0 |
| Trunk volume (cu.ft.) | 13.5 | 13.2 | 13.2 |
| Base price | $9,414 | $8,878 | $7,799 |
| Price as tested | $13,666[1] | $11,423[2] | $10,765[3] |

Major options (over $100): [1]1.8-liter turbo engine $800, A/C $645, cassette-radio $494, automatic transmission $390; [2]A/C $645, cassette-radio $504, custom interior $251; [3]turbo engine package $815, A/C $701, convenience package $310, cassette-radio $246

## Parts and service

Parts prices are manufacturer's suggested retail, rounded off to the nearest dollar

| | | | |
|---|---|---|---|
| Brake pads, front | $ 28 | $ 35 | $ 51 |
| Brake pads/linings, rear | 20 | 35 | 36 |
| Front shock/strut insert | 114 | 114 | 50 |
| Alternator | 228 | 228 | 154 |
| Fuel pump | 122 | 80 | 36 |
| Ignition module | 40 | 53 | — |
| Grille | — | 31 | 79 |
| Front bumper | 193 | 161 | 250 |
| Windshield | 286 | 286 | n.a.* |
| Taillight lens | 56 | 108 | 19 |

* New model, price not available at press time

## PS serviceability ratings

| | | | |
|---|---|---|---|
| Checking oil level | 5 | 5 | 5 |
| Checking coolant level | 5 | 5 | 5 |
| Adding oil | 5 | 4 | 5 |
| Changing oil filter | 2 | 3 | 5 |
| Changing spark plugs | 4 | 2 | 5 |
| Changing belts | 2 | 2 | 4 |
| Changing radiator hoses | 4 | 3 | 4 |
| Changing heater hoses | 2 | 2 | 3 |
| Changing fuses | 4 | 4 | 5 |
| Spare tire access | 4 | 4 | 4 |

(Ease of service: 5-excellent, 1-poor)

# HOW IT WORKS

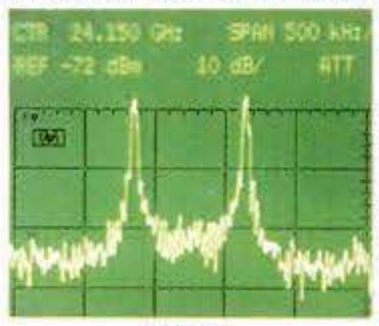
With traffic radar and Rashid VRSS both transmitting on the same frequency (24.150 GHz), normal receiver technology can't tell one from the other. Even when you scrutinize K band with a digital spectrum analyzer, the two signals look alike (Figure 1).

We needed a difference, even a subtle one, the electronic equivalent of a human fingerprint. Magnifying the scale 100 times was the key (Figure 2). The Rashid signal then looks like two separate traffic radars spaced slightly apart in frequency, each being switched on and off several thousand times a second.

### Resisting the easy answer

Knowing this "fingerprint," it would have been possible—although not easy—to design a Rashid-recognizer circuit, and have it disable the detector's warning section whenever it spotted a Rashid.

Only one problem. With this system, you wouldn't get a warning if radar were ever operating in the same vicinity as the Rashid. Statistically this would be a rare situation. But our engineers have no interest in 99 percent solutions.




RASHID

Figure 2: An electronic close-up reveals two individual signals.

### When the going gets tough...

The task then became monumental. We couldn't rely on a circuit that would disregard two K band signals close together, because they might be two radars. We couldn't ignore rapidly switched K band signals, because that would diminish protection on pulsed radar (the KR11) and "instant-on."

### A whole new deal

The correct answer requires some pretty amazing "signal processing," to use the engineering term. The techniques are too complex to go into here, but as an analogy of the sophistication, imagine going to a family reunion with 4.3 million attendees, and being able to find your brother in about a tenth of a second.

Easy to say, but so hard to accomplish that our AFR (Alternating Frequency Rejection) circuitry couldn't be an add on. It had to be integrated into the basic detection scheme, which means extensive circuitry changes. And more paperwork for our patent department.

If you own an ESCORT or PASSPORT: The new AFR circuitry is incorporated in ESCORTs from number 1,200,000, and PASSPORTs from 550,000. If your unit is earlier, read on.

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# Radar warning breakthrough #4 is now available from the same engineers who made #1, #2, and #3

Bad news for radar detectors. The FCC (Federal Communications Commission) has cleared the Rashid VRSS for operation on K band.

### What's a Rashid VRSS?

The Rashid VRSS is a collision warning system using a radar beam to scan the vehicles path, much as a blind person uses a cane. It may reduce accidents, which is very good news.*

### Now for the bad news

Unfortunately, the Rashid transmits on K band, which is one of the two frequencies assigned to traffic radar. Rashid speaks a radar detector's language, you might say, and it can set off detectors over a mile away.

Faced with this problem, we could hope Rashid installations will be few. Or we could invent a solution.

### Opportunity knocking

Actually, the choice was easier than it sounds, because our engineers are in the habit of inventing remarkable solutions. In fact, in the history of radar detection, only three advancements have qualified as genuine breakthroughs, and all three came from our engineers.

Back in 1978, they were first to adapt dual-band superheterodyne technology to the problem of traffic radar. The result was ESCORT, now legendary for its performance.

In 1983, when a deluge of cheap imported detectors was found to be transmitting on radar frequency, our engineers came through again, this time with ST/O/P™, a sophisticated circuit that could weed out these phony signals before they triggered an alarm.

Then in 1984, using SMDs (Surface Mounted Devices), micro-electronics originally intended for satellites, these same engineers designed the smallest detector ever. The result was PASSPORT, renowned for its convenience.

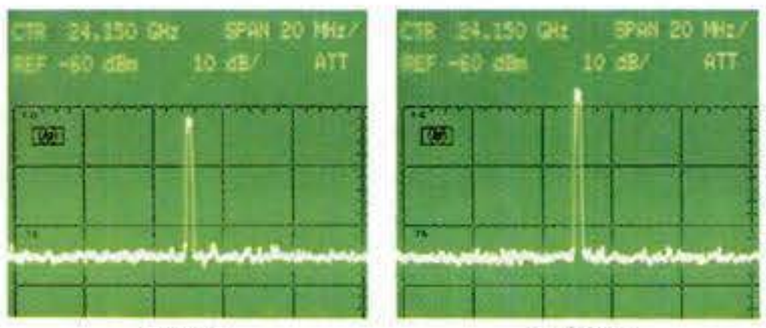
*For more information on Rashid VRSS collision warning system, see *Popular Science*, January 1986.

### They said it couldn't be done

Now we're introducing breakthrough number four. In their cleverest innovation yet, our engineers have found a way to distinguish Rashid from all other K band signals. It's the electronic equivalent of finding the needle in a haystack. The AFR™ (Alternating Frequency Rejection) circuit isolates and neutralizes all Rashid signals, yet leaves the radar detection capability undiminished for your protection.

### No waiting for the good stuff

When testing proved that AFR was 100 percent effective, we immediately incorporated it into ESCORT and PASSPORT. Our policy is to make running changes—not model changes—whenever a refinement is ready. That way our customers always get the latest science.




RADAR RASHID

Figure 1: A digital spectrum analyzer scanning the entire width of K band can't see the difference between radar and Rashid.

AFR is fully automatic. There are no extra switches or lights. Nothing for you to bother about. The Rashid problem simply goes away.

Last year *Road & Track* called us **"the industry leader in detector technology."** We intend to keep earning our accolades.

### We make shopping easy too

Call us toll free. We'll answer all your questions. If you decide to buy, we'll ship the next business day at our expense. For $6.00 extra, Federal Express will deliver to you within two business days of shipment.

If you're not completely satisfied within 30 days, return your purchase. We'll refund *all* your money, including return postage, no questions asked.

We specialize in breakthroughs. Can we make one for you?

### Order Today

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**PASSPORT®**
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**Pocket-Size Radar Protection $295**
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Cincinnati Microwave
Department 016N
One Microwave Plaza
Cincinnati, Ohio 45296-0100

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Cincinnati Microwave is committed to constant advancement in radar warning technology. But we don't believe in planned obsolescence. Therefore, we are working out a plan to offer upgrades for most pre-AFR models (PASSPORTs under number 550,000, and ESCORTs from 200,000 through 1,199,999). Since non-AFR units will require extensive modifications, new procedures and facilities are being developed to ensure a quality conversion. For details and costs of this retrofitting program, see our ad in the January issue of this magazine.

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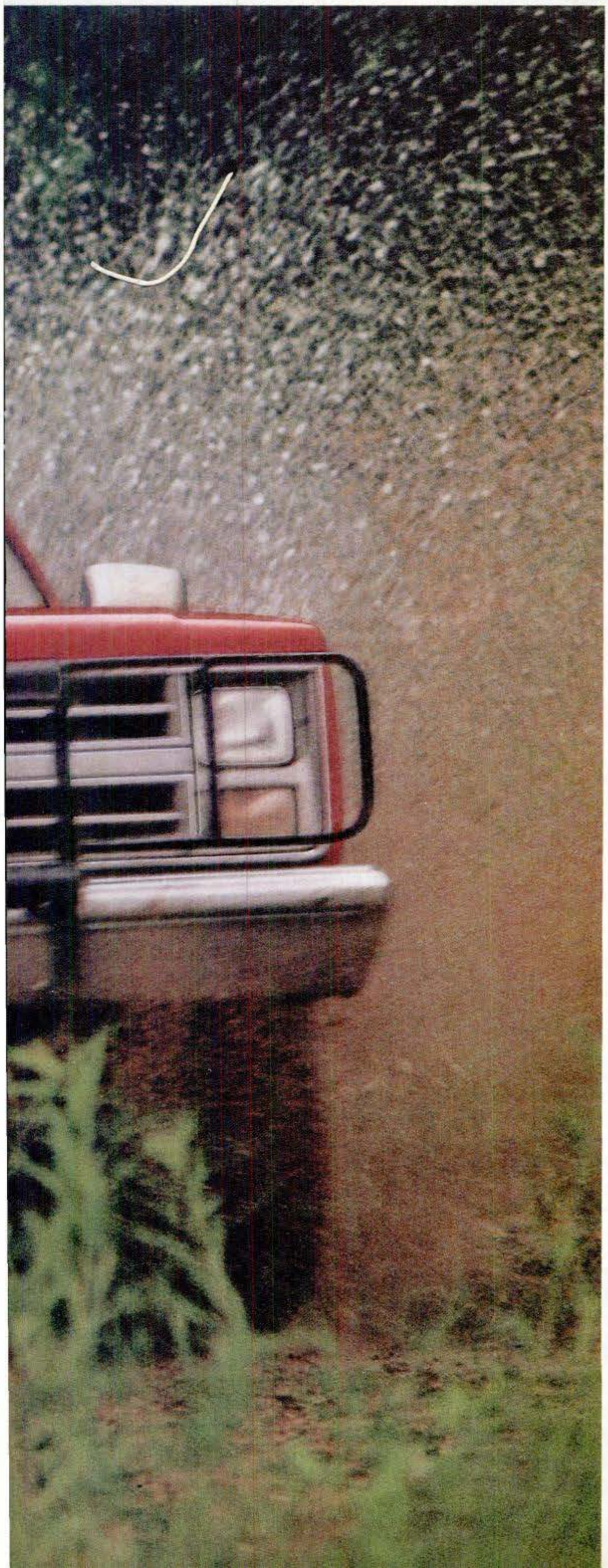
# ELECTRONIC

# FUN INJECTION



There's new performance under the hood of every big Chevy Pickup. You turn the key, tap the pedal. And take off.

**NEW FUEL-INJECTED POWER.**

Power you can feel. Electronically fuel-injected power standard on every gasoline engine in every Chevy Pickup. And when you match the available fuel-injected V8 thunder with 4-wheel drive, you're ready to reach new heights of pure flat-out fun.

**TAKE OFF WITH 350 V8 POWER.**

The 350 V8's now available in every full-size Chevy, including 10 Series.

And now fuel-injected up to 210 HP and 300 lbs.-ft. of torque. To get you started quick. And move you out even quicker.

**HAUL YOUR FUN WITH YOU.**

Big Chevy 4x4s can haul full-size payloads. And take you places you wouldn't dare in lesser trucks.

But why not leave your bikes and friends at home and make it just you and your big, tough Chevy 4x4? And not let anything slow you down.

The new fuel-injected Chevy 4x4s. Waiting to inject a little fun into your life.

Let's get it together... buckle up.

**NOTHING WORKS LIKE A CHEVY TRUCK**

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# NOW YOU CAN CONQUER RUST!

## New NEUTRA RUST Gets Rid of Rust For Good!

**NOT A PAINT, NOT A COVER-UP,** but an entirely new and revolutionary process for eliminating rust. Neutra Rust was originally developed to control the incredible rust on oil rigs in the North Sea and on ships of the Royal Navy. Think of the rust problems they have! Naturally they use vast quantities of Neutra Rust and buy it in huge 50 gallon drums. For a long time that was the only way you could buy it. But at last Neutra Rust is available in smaller sizes for home and shop.

Now *you* can get rid of rust for good just the way they do at industrial and military installations all over the world!

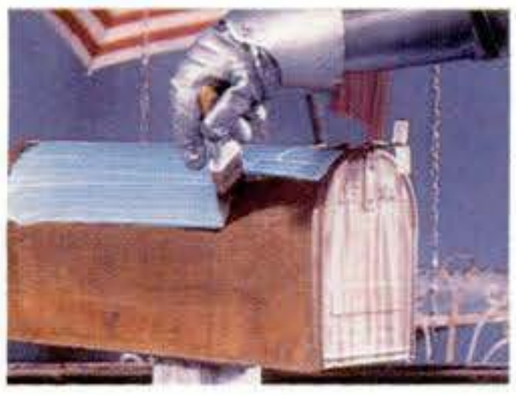
**WHAT NEUTRA RUST DOES**

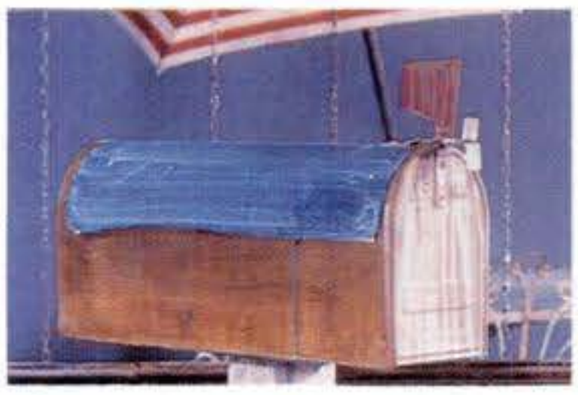
Neutra Rust is like nothing you've ever used before. It's amazing! No tiresome scraping, wire brushing and sanding to get down to bare metal. Neutra Rust works best applied right over rust! It *penetrates* the rust. Gets right down there and chemically changes the rust into an entirely new substance—a hard, black, paintable compound called fersoferric. The rust is gone—not just covered up—GONE! For good. It no longer even exists.

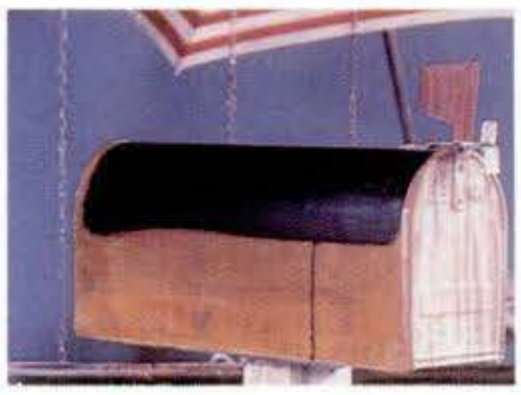
**NEUTRA RUST IS EASY TO USE**

First knock off the loose or scaly rust, but leave the rest of the rust there. (Remember Neutra Rust works *with* rust.) Then just brush Neutra Rust on. Within minutes that rust will be gone and the new surface will be there. That's all there is to it. Clean up is easy, too. Just soap and water.

**YOU CAN ACTUALLY SEE NEUTRA RUST WORK!**







When you first brush on Neutra Rust it is white. Then, as you watch, it turns pale green, then darker green, then finally a deep, wrought-iron black. What you have seen is the rust being chemically converted. The hard new surface can be painted any color you want, or left as is.

**USE NEUTRA RUST ON:** Automobiles • Boats Outdoor Furniture • Drain Pipes • Gutters Mailboxes • Swing Sets • Tools • Lawnmowers Appliances • Toys • Bikes • Wagons • Hinges Railings • *Anywhere There's Rust!*

For further information about Neutra Rust write to:
Jeff Morrison, VP Marketing
New York Bronze Powder Co., Inc.
777 Dowd Avenue, Elizabeth, New Jersey 07201

nybco

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## Street dancers

[Continued from page 22]

Take the Sundance, for instance. Designed primarily as an economy car, it can hold two adults comfortably in front and two good-size children in the rear. The Sundance also has a large, deep trunk, with a hatch and 60-40-split rear seat back that allow the car to haul anything from grocery bags to water skis.

This economy-car heritage resulted in a sports sedan with some annoying rough edges, though. Adding a turbo to the 2.2-liter four made an engine that generates lots of power. But it's also noisy when pushed, and the turbo whines whenever it's asked to do any work. The clutch pedal was heavy and the shift linkage notchy. When asked to perform like a sports car, the Sundance feels a touch awkward on its feet. It took some practice before I could drive the car smoothly.

Still, at $10,765 complete with the turbo engine, cassette radio, and air conditioning, the Sundance is a bargain. It also looks as easy to service as any car currently made. For example, the black plastic cover on the center of the instrument panel simply snaps off, allowing the boost gauge, rear defroster switch, heater controls, and radio to be removed in minutes. All flashers and buzzers reside behind a small door in the glove box. Even the oil filter, which mounts on front of the engine, is easy to reach. And like all 1987 Chryslers, the Sundance has a stainless-steel exhaust system, which should reduce trips to the muffler shop.

If the Sundance seemed a bit appliance-like, the Cavalier Z24 felt like something from the sporting-goods department. The car clearly is intended for those who desire a Camaro or Corvette but can't swing the payments. And because it is smaller and easier to maneuver, I found the Z24 far more enjoyable than either of its big brothers.

The key to the Z24's personality is its engine, a 2.8-liter fuel-injection V6. Though it produced far less power than either turbocharged four, the engine's burbling exhaust and smooth torque curve made it the choice of almost everyone who drove the three cars.

The worst that could be said about the rest of the car was that it was thoroughly competent, far better than the crude, uncomfortable J-cars of the early 1980s. Some testers thought the manual transmission needed a fifth gear (which it will get for 1987), and no one cared much for the electronic instruments. But the comfortable seats, firm ride, and quick steering all seemed dedicated to the same end—a car that's fun to drive. As a result, the Z24 was more balanced and refined than the other two.

*Continued*

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# Vision Breakthrough

*When I put on the pair of glasses what I saw I could not believe. Nor will you.*

They look like sunglasses.

*By Joseph Sugarman*

I am about to tell you a true story. If you believe me, you will be well rewarded. If you don't believe me, I will make it worth your while to change your mind. Let me explain.

Len is a friend of mine who has an eye for good products. One day he called excited about a pair of sunglasses he owned. "It's so incredible," he said, "when you first look through a pair, you won't believe it."

"What will I see?" I asked. "What could be so incredible?"

Len continued, "When you put on these glasses, your vision improves. Objects appear sharper, more defined. Everything takes on an enhanced 3-D effect. And it's not my imagination. I just want you to see for yourself."

When I received the sunglasses and put them on I couldn't believe my eyes. I kept taking them off and putting them on to see if indeed what I was seeing through the glasses was indeed actually sharper or if my imagination was playing tricks on me. But my vision improved. It was obvious. I kept putting on my cherished $100 pair of high-tech sunglasses and comparing them. They didn't compare. I was very impressed. Everything appeared sharper, more defined and indeed had a greater three dimensional look to it. But what did this product do that made my vision so much better? I found out.

### DEPRESSING COLOR

The sunglasses (called BluBlockers) filter out the ultraviolet and blue spectrum light waves from the sun. You've often heard the color blue used for expressions of bad moods such as "blue Monday" or "I have the blues." Apparently, the color blue, for centuries, has been considered a rather depressing color.

For eyesight, blue is not a good color too. There are several reasons. First, the blue rays have the shortest wavelength in the visible spectrum (red is the longest). As a result, the color blue will focus slightly in front of the retina which is the "focussing screen" onto which light waves fall in your eye. By eliminating the blue from the sunglasses through a special filtration process, and only letting those rays through that indeed focus clearly on the retina, objects appear to be sharper and clearer.

The second reason is even more impressive. It is not good to have ultraviolet rays fall on our eyes. Recognized as bad for skin, uv light is worse for eyes and is believed to play a role in many of today's eye diseases. In addition, people with contact lenses are at greater risk because contacts tend to magnify the light at their edges thus increasing the sun's harmful effects.

Finally, by eliminating the blue and uv light during the day, your night vision improves. The purple pigment in your eye called Rhodopsin is affected by blue light and the eyes take hours to recover from the effects.

### SUNGLASS DANGER

But what really surprised me was the danger in conventional sunglasses. Our pupils close in bright light to limit the light entering the eye and open wider at night—just like the aperture in an automatic camera. So when we put on sunglasses, although we reduce the amount of light that enters our eyes, our pupils open wider and we are actually allowing more of the blue and ultraviolet portions of the light spectrum into our eyes.

BluBlockers sunglasses are darker at the top to shield out overhead light. The lens used is the CR-39 which most eye doctors will tell you is one of the finest materials you can use for glasses and is manufactured under license.

The frames are some of the most comfortable I have ever worn. The moulded nose rest will fit any nose. The hinge causes the frames to rest comfortably on your face and can be adjusted for almost any size face.

We also have a clip-on pair that weighs less than one ounce. Both come with a padded carrying case and an anti-scratch coating.

I urge you to order a pair and experience the improved vision. Then take your old sunglasses and compare them to the BluBlockers. See how much clearer and sharper objects appear with BluBlockers. And see if your night vision doesn't improve as a direct result. If you don't see a dramatic difference in your vision—one so noticeable that you can tell immediately, then send them back anytime within 30 days and I will send you a prompt and courteous refund.

### DRAMATIC DIFFERENCE

But from what I've personally witnessed, once you use a pair, there will be no way you'll want to return it.

Astronomers from many famous universities wear BluBlockers to improve their night vision. Pilots golfers, skiers, athletes—anyone who spends a great deal of time in the sun have found the BluBlockers indispensable.

Our eyes are very important to us. Protect them and at the same time improve your vision with the most incredible breakthrough in sun glasses since they were first introduced. Order a pair or two at no obligation, today.

To order, credit card holders call toll free and ask for product by number shown below or send a check plus $4 for delivery.

BluBlockers (0020PS) . . . . . **$59.95**
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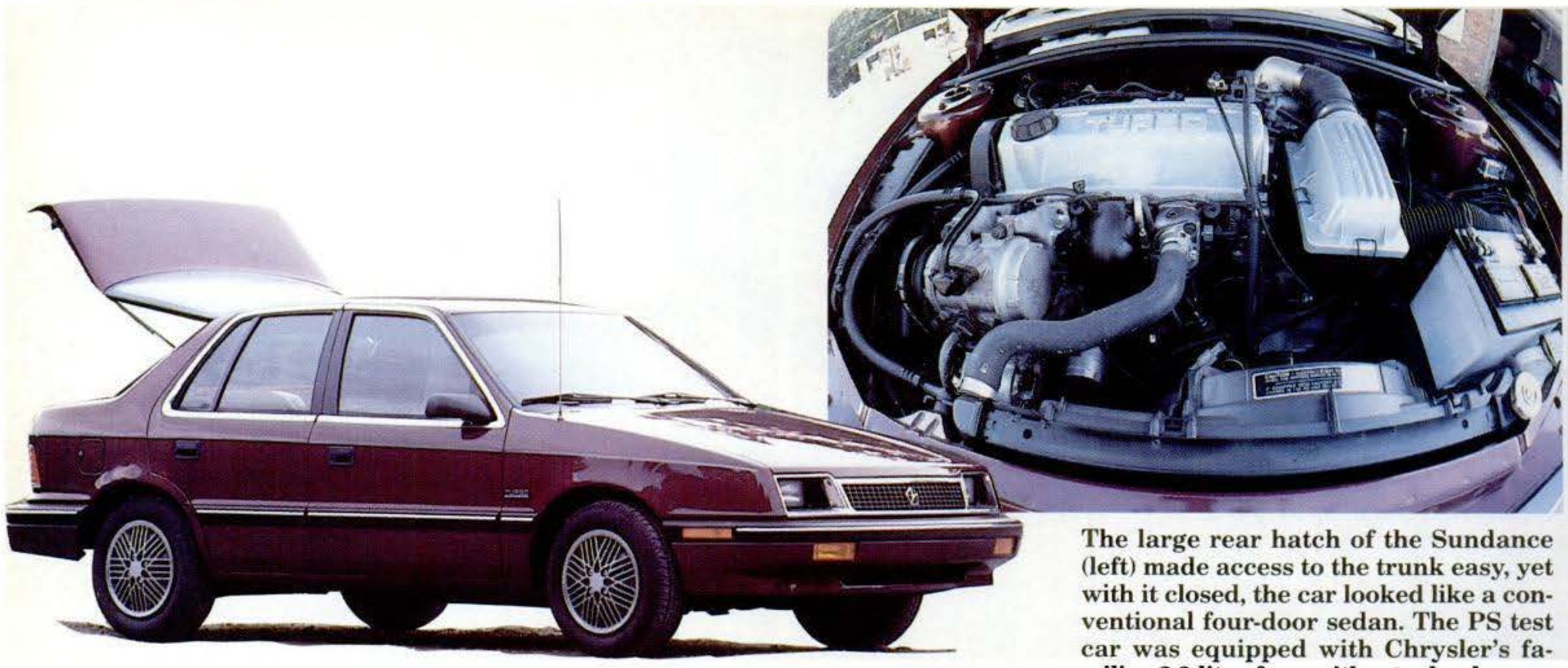

PHOTOS BY JOHN NEITZEL

**The large rear hatch of the Sundance (left) made access to the trunk easy, yet with it closed, the car looked like a conventional four-door sedan. The PS test car was equipped with Chrysler's familiar 2.2-liter four with a turbocharger and fuel injection. Service access for the engine was excellent.**

In contrast, the Skyhawk was an automotive Dr. Jekyll and Mr. Hyde. Driven at moderate speeds, the small Buick felt smooth and civilized. Except for a slightly rough idle, the 1.8-liter turbocharged four ran quietly. The ride was comfortable, and the car was relaxing to drive for long stretches on the turnpike.

The Hyde side of the Skyhawk's personality erupted anytime you nailed the throttle. After hesitating a moment while the turbocharger gained speed, the car would leap forward, with the engine howling angrily and the transmission snapping off shifts. By choosing the turbo four instead of the Chevy-built V6, Buick picked up 30 more horsepower. Whether the acceleration that results is worth the sound and fury under the hood, only individual buyers can decide. (The 1987 Buick Skyhawk will get yet another 15 horsepower, as well as a five-speed manual gearbox.)

## Author's pick

*For me, the choice in this group is between the smooth, muscular feel of the Cavalier and the Sundance's utility and ease of service. Since I keep cars forever and do my own repairs, the Sundance gets the nod.* PS

## Views from the driver's seat

Take one hot power plant and a lightweight body shell stuffed with options; toss in some suspension stiffening and sport wheels, and a pinch of fancy exterior graphics for flavor. Then, stir up the market with some spicy advertising, and serve hot to an American audience starved for sporty cars.

Back in the late '60s and early '70s that was the simple, reliable recipe for satisfying the American public's taste for performance cars. But obviously, the U.S. market is no longer starved for sporty cars. Unfortunately, sometimes American car makers still think they can get away with the same rough-edged vehicles they used to build.

If there's one thing that goes against my grain, it's a car that pretends to be more than it is. I'm not suggesting that the fat, sticky tires and firm-ride suspensions on these three cars didn't contribute to their performances, but I think it's interesting to note that tiny economy cars with more compliant rides, far skinnier tires, and engines with less power have gone faster, stopped shorter, and handled better. And those econoboxes provided all that performance for about half of what these heavily optioned models cost.

My first disappointment with this trio came in the brake lane. Despite their light weight and wide tires, none of these sedans stopped particularly well. Mediocre performance also was the rule in the acceleration tests. Zero-to-sixty times were not much better than those of several family sedans and economy cars PS has tested recently. Only the results in the handling tests were in keeping with the aggressive image these cars try to project.

The mediocre driving environment also left me with a lukewarm impression. The Cavalier interior was comfortable, but the electronic instruments appeared cheap and were barely readable in normal daylight. The Skyhawk's front buckets and leather steering wheel got good grades. But though the needle-type gauges were easier to read than the Chevy's electronic displays, they were plagued by reflections from their plastic fascia.

The Plymouth also had a terrific steering wheel, but the gauges and switches looked and felt cheap. And while the front buckets appeared expensive and felt soft for the first few miles, I soon found my back sagging from lack of support.

The bottom line on all three of these cars is that they're badly in need of additional refinement. They're all a bit like unripened fruit: not quite fit for public consumption.

I'm not sure any of these cars deserve to be recognized as a winner. But forced to make a choice, I'd take the Cavalier Z24 because it stopped best and offended least. —Jack Keebler

Taking a simple, unpretentious car and passing it off as an upscale fantasy has been a habit that Detroit car makers can't seem to break.

The cars in this group take two of the best transportation-special chassis in the business —Chrysler's basic front-drive platform and GM's subcompact J-body—and add power and flash in an attempt to create low-cost sporty cars.

How well they succeed depends largely on your expectations. I found the acceleration impressive, but the remainder of the package doesn't get out of the dime-a-dance league, largely because the basic power train and chassis are unchanged from those of the transportation specials. Shift precision, engine flexibility (except for the Chevy V6), and all-around handling seem lacking. Yet because Detroit prices its options for maximum profits, the cost of the glamour these cars provide can come high.

The show-versus-go argument will never end, and neither will the argument over whether you're better off with a stripped version of a high-priced car or a loaded version of some lesser breed. Gimmicks like slotted backlight covers seem only to raise adolescent expectations. Maybe that's why I keep hearing mom saying, "Sure she's cute, but would you really want to marry her?"—Dan McCosh



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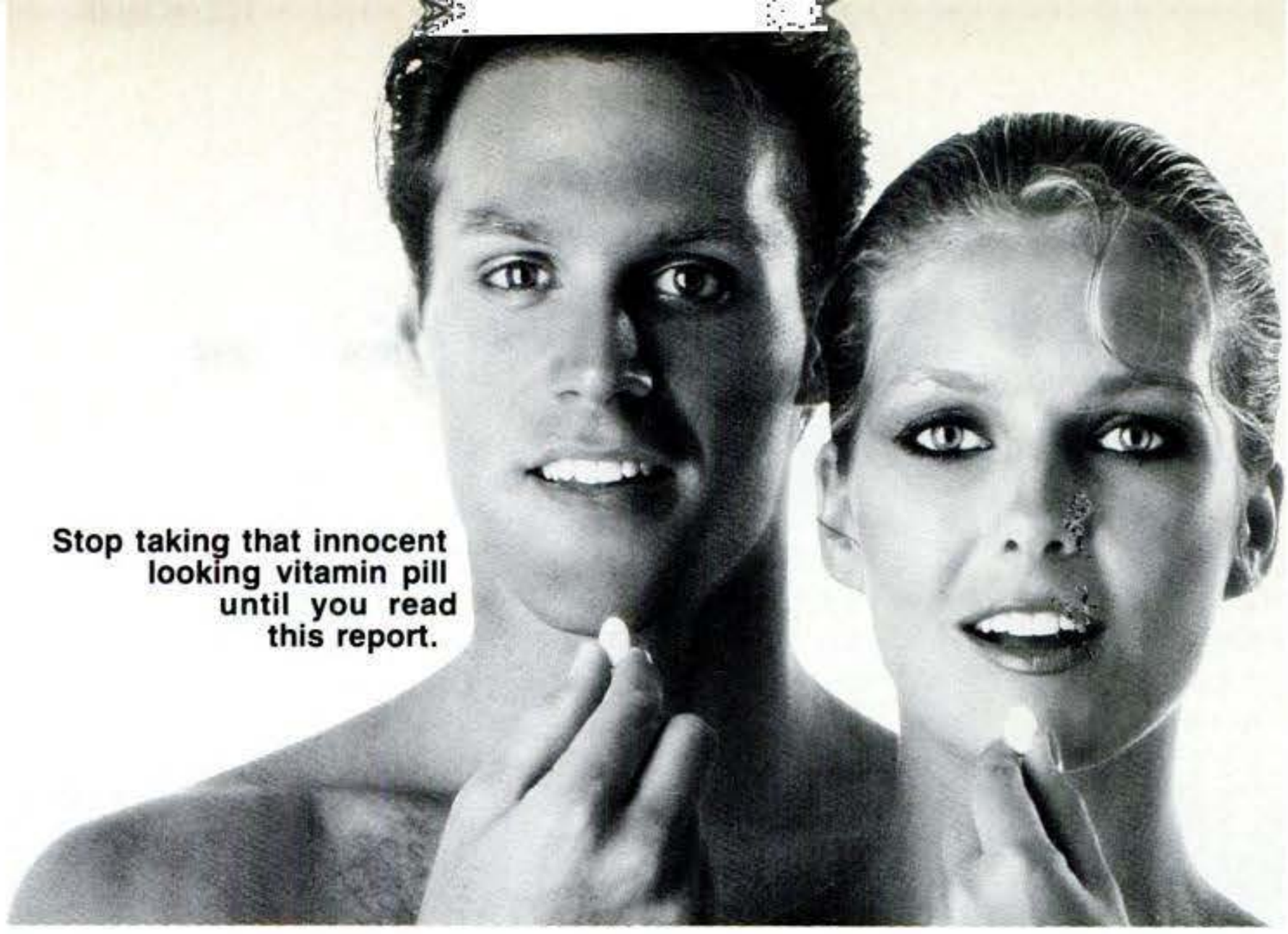
# Stop Taking Vitamins

*If you think the vitamins you are now taking are doing you any good, wait until you hear the latest news on why they may not.*



Stop taking that innocent looking vitamin pill until you read this report.

*By Joseph Sugarman*

This may come as a shock. But according to the latest research, those vitamins that you take every day may be doing you absolutely no good. For example.

**FACT:** Vitamins should be taken after a meal—never before. The body must first have protein, fats, or carbohydrates in the digestive tract to properly break down the vitamins for proper absorption.

**FACT:** Your body has a need for a natural vitamin balance. Too much of one vitamin may cause another vitamin to be less effective. For example, vitamin A should be taken with Vitamin E but excessive iron should not.

**FACT:** If you take too much calcium, you may deplete the magnesium in your system. And you need magnesium to convert food into energy.

**FACT:** Some vitamins are best taken in the morning and others at night. For example, the trace element chromium helps break down the sugar in your food which in turn creates energy—perfect to start the day. But at night you should take Calcium which has a relaxing effect—perfect for the evening.

**FACT:** Athletes or people who exercise a great deal need vitamins more than people who don't exercise. Vitamins are depleted at a much faster rate during exercise than during any other period of time.

But there was a series of other facts that surprised me too. For example, despite everything I've just mentioned on the care in taking vitamins, there are those people who absolutely need vitamins because of the mental or physical activity that they undergo. People on a diet, under stress, those who smoke, women who take contraceptives and even those who take medication—all rob their bodies of some of the essential vitamins and minerals that they need to help combat the various habits or conditions they are under.

And with proper vitamins in the proper balance and at the proper times, you will have more energy and vitality. Little changes may take place. Your nails may become stronger, your hair may become thicker and your skin may be more elastic which will keep you younger-looking longer.

### DOCTORS HAD IDEA

About two years ago a group of doctors had an idea. They realized that many people were taking vitamins and not really noticing any difference in their health. They also realized that, based on the latest nutritional findings, the vitamins people were taking may not have been doing them any good. So they formed a group of advisors consisting of nutritionists, dieticians, dermatologists, biochemists and physicians, and they worked on the development of a vitamin program that incorporated all of the latest information on vitamins, minerals, nutrition, food processing—even stress research. They realized that vitamins were a two-edged sword. They could either help you or hurt you.

They then took all this information and developed the most effective combination of vitamins and minerals, formulated four tablets—one for the morning and one for the evening—and one for men and one for women and then started a test program that lasted over two years. The results speak for themselves.

It was perfect for weight loss programs and it was perfect for people under stress. It helped many increase their energy levels. Smokers benefited. Some under medication benefited. And before long the company that had developed the program became the fastest growing vitamin company in the United States. And no wonder.

### SEVERAL BENEFITS

With the proper vitamin and mineral balance, taken in the right quantity in the right combination and at the right time, several obvious benefits occur. First, you may develop a better mental outlook because you've got the energy and the zest to accomplish more. As a result of the trace elements copper, zinc and manganese, your body is helped to make its natural anti-aging enzymes that keep you fit. Improvements in your vitality translate into everything from better job performance to a more fulfilling sex life.

JS&A has been selected by the vitamin company to introduce their medically formulated vitamin program. Every two months we send you a two month's supply of 120 fitness tablets—one to be taken after breakfast and one after dinner.

During the first two months, you will have ample opportunity to notice the difference in your energy level, your mental attitude and your overall stamina. You should notice little things too, like the strength of your fingernails, your thicker hair. Your complexion may even take on a glow. Some of you may notice all of these changes and others may notice just a few. But you should notice a change.

If for any reason, you do not notice a change, no problem. Just pick up your phone, and tell us not to send you any more vitamins. And if you ask for a refund, you won't even have to send the empty bottle back. It's yours free for just giving us the opportunity to introduce our vitamins. However, if you indeed do notice a difference (which we are confident you will), you'll automatically receive a two-month's supply every eight weeks.

### ONE MORE INCENTIVE

I'm also going to give you one more incentive just to let me prove to you how powerful this program really is. I will send you a bonus gift of a fitness bag with your first order. This beautiful bag will hold all your fitness gear and it's great too for short vacation trips. It's a $20 value but it's yours free for just trying the vitamins. Even if you decide not to continue, you keep the fitness bag. I am so convinced that you will feel and see a difference when you take these vitamins that I am willing to gamble on it with this unusual offer.

Vitamins indeed are important. And with today's research and new nutrition technology, you have a greater chance to achieve the fitness and health levels that may have eluded you with the typical store vitamins or the poor advice we may get in health food stores or from friends. Here is a safe, risk-free way to get one of the best vitamin programs in the country, formulated by a physician, with the right combination of vitamins, minerals and trace elements, in a convenient program that assures you of delivery every two months. I personally take and highly recommend them. Order your trial quantity, today.

To order, credit card holders call toll free and ask for product number (shown in parentheses) or send a check and include $2.50 for delivery.

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# Did life begin in clay?

For years investigators who seek the origins of life adhered mostly to the theory that life's antecedents were organic molecules that got together fortuitously in a "primordial soup." Now a few scientists are postulating that life had a more solid beginning: in ordinary clay.

The latest evidence for the clay theory comes from experiments at NASA's Ames Research Center, in Mountain View, Calif., where a team of biochemists demonstrated that clays can store and transfer energy.

The "primordial soup" theory, proposed in the 1930s by Russian scientist A. I. Oparin, suggests that the precursors of life were simple organic molecules that were formed in Earth's primeval atmosphere when lightning or solar ultraviolet rays triggered chemical reactions among the ammonia, nitrogen, methane, and water vapor lurking there. Once formed, the molecules were rained into the oceans, where, after millions of years and billions of random chemical reactions, a complex organic molecule that could replicate itself evolved.

But more-recent evidence—from ancient rocks on Earth, the moon, and meteorites—suggests that the requisite ammonia and methane were not abundant in Earth's early atmosphere.

## Catalyst and concentrator

The new clay theory, proposed by Dr. A. G. Cairns-Smith of the University of Glasgow, Scotland, suggests that the evolution of life was patterned, not random. It has long been known that clays can act as catalysts in chemical reactions and can select certain chemicals. Observations at Ames and elsewhere have shown that clays could have helped select and concentrate the raw materials of life (perhaps leaching them from the oceans during high tide) and could have triggered further reactions of these building blocks, eventually producing incipient proteins and DNA. In addition, experiments in Germany have suggested that clays exhibit other lifelike functions, including self-replication.

The most recent Ames experiments indicate that clay can absorb, store, and transfer energy. That energy could have triggered the chemical reactions that formed primitive proto-organisms. The researchers, led by Dr. Lelia Coyne, measured ultraviolet-light release from clays as evidence of their energetic processes. They found that light was emitted when the clays were wetted, dried, ground up, fractured, or irradiated with gamma rays. Similar conditions could be produced in nature by earthquakes, freeze-thaw cycles, tidal cycles, and erosion.

Coyne proposes that clays store energy, such as that released during natural radioactive decay, by capturing highly energetic electrons in irregularities or defects in their crystalline or atomic structure. The mechanical energy associated with rock movement could also possibly be absorbed and stored (as well as released), Coyne and her team suggest.

"There is nothing in clays that would make them the only minerals capable of carrying out the chemical processes that led to life," Coyne notes, "but clays do have special properties among minerals." —*V. Elaine Gilmore*


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# Trade Show Case

*He designed it for trade shows after one of the biggest embarrassments in his career.*

**Spending $3,589 for a briefcase was ridiculous. "I lost sight of the costs."**

*By Joseph Sugarman*

Cliff is a friend of mine who attends trade shows and conventions. One day, in the middle of a large crowd, while he was searching for a paper, the entire contents of his briefcase spilled all over the convention floor. "It was the most embarrassing moment of my business career," confided Cliff, "for at the same time, out fell my red underwear."

Determined not to let this happen again, Cliff decided to design a briefcase that he could take to trade shows and that was actually designed for trade shows. "I was going to design a custom case regardless of the cost."

### EXECUTIVE TORTURE

Cliff designed a case with all Velcro fasteners so there's nothing to snap or unbuckle. He also designed it with the lightest yet strongest material he could find—420 denier nylon—material that could withstand torture and still look like new.

To carry the case, he made two provisions. One is a handle on the top of the case and the other is a strap attached to the sides. If you've ever wanted to use both hands to pick up a brochure at a booth or sign a credit card voucher at an airport, the shoulder strap lets you carry the briefcase over your shoulder with both hands free yet the strap is short enough to hang along the side of the case.

The pockets were also designed very cleverly. First, Cliff designed a large brochure-sized pocket on the outside of the case. This way you can easily pick up brochures at a trade show, stuff them into the case's pocket—all without opening the case. This also comes in handy at an airport to hold your tickets—things you want to reach for easily.

### TWO POCKETS

On the other side of the case are two pockets for convention programs, glasses or letter-sized documents or brochures. And finally on the inside, there are two compartments for holding your larger papers and documents. The flap that covers the top of the case also has a generous amount of Velcro so that regardless of how much or how little you have in the case you'll always be able to firmly close it.

And that's another point. The case expands up to 4 inches to fit its contents. More importantly, it also collapses automatically so your case never looks too big or too small for what you're carrying. And it's exceptionally lightweight—only 2 pounds 14 ounces compared to the typical 6 pound briefcase. The case measures 12" x 17" with the outer compartment measuring 8" x 16."

Cliff carried his case with him to trade shows for months but he still wasn't satisfied. He refined it even further by putting a small Velcro tab on the outside pocket to give the case a better appearance while protecting the contents of the open flap and he installed a special inner compartment to hold three pens, your business cards or even a small calculator. Then he framed the entire case with rugged nylon piping—a great looking final touch.

### ONLY $3,589

He finally had achieved perfection. Not only for his trade show activities but for his everyday travel and business use. And it only cost him $3,589. "I realize that's ridiculous to pay for a personal case but when I put my mind to something, I lose sight of the cost."

Cliff used his case for about 18 months before I met him. "A great looking case," I commented. "Where did you get it?"

Cliff told me the whole story. I was impressed—so impressed that I decided to market the very same case that Cliff designed and spent over $3,000 to make and have made it available to you for only $69.95. The product will retail in stores later this year for over $100.

But to make my offer so irresistible that you'd be silly not to buy it from me, especially after reading this far, I'm going to throw into each case gifts—a collection of other products worth $70. In short—the case you receive will contain $70 in surprises.

### THREE BIG REASONS

Why am I doing this? There are three reasons. First, hopefully you'll become one of our new customers. Secondly, the other free gifts are leftovers from other promotions that, quite frankly, I just want to get rid of. And finally, I'm really a nice guy.

Order your JS&A Trade Show briefcase from me. Use it for a full month. If it doesn't replace what you currently use or if you're not completely satisfied, return the case and the contents (our contents, not yours) and we'll send you a full refund. But we're convinced that you'll really appreciate the convenience of using the JS&A Trade Show briefcase in all your personal and business activities and you'll order more.

### CLIFF REALLY HAPPY

Cliff is quite happy now. He's making a pretty nice royalty on his case and he's really quite proud that he was the designer of what will become one of America's best selling executive briefcases. It has even changed his lifestyle. He no longer wears red underwear. Order your case at no obligation today.

To order, credit card holders call toll free and ask for product by number shown below or send a check plus $5 for delivery.

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# Alternate-Energy Answers

By JAN F. KREIDER

Jan F. Kreider is a consulting engineer specializing in the design and economic analysis of solar-energy and energy-conservation systems. He is the author of several books on solar technology and a lecturer at the University of Colorado.

## Vegetable-oil antifreeze?

I have a Revere solar water heater that uses a 50/50 solution of propylene glycol. I need more antifreeze but can't find any in the Tucson area. Someone suggested using vegetable oil instead. Would this work?

James Wesaneu, Tucson, Ariz.

*One source of propylene glycol is Dow Chemical Co. (Midland, Mich.). It markets this product under the trade name Dowfrost. Call 800-258-2580 and ask for the local distributor. Under no circumstances should you use vegetable oil in a solar system! It will cause extensive and expensive damage.*

## Thermal bonding

I have some old ½-inch copper pipe, which I'd like to use to build a solar collector. How can I create a good thermal bond between the tubes and the aluminum absorber plate?

Roger N. Johnson, Mahwah, N.J.

*You recognize the importance of a good thermal bond for good collector performance. A mechanical bond has been used successfully by a number of manufacturers over the years. But you cannot simply lay the pipe on a flat plate and hope to get an adequate bond. I suggest you take your absorber plates of aluminum to a local sheet-metal shop and have them press ½-inch semicylindrical grooves in the plate at six-inch intervals. Then you can clamp the pipe every foot or so to the plate and have a good bond. You might check at a plumbing store for some thermally conducting epoxy or high-temperature grease.*

## Reducing exhaust loss

How can I reduce the loss of heated air in winter and cooled air in summer caused by the exhaust of my clothes dryer in the utility room?

Jordan T. Bolton, Harlingen, Texas

*In summer, I recommend using an outdoor air supply to the dryer room, which could be isolated from the rest of the house by closing the dryer-room door. In winter, I would use indoor air because it will not be heated by electricity as is the dryer-heated air. If you filter the dryer outlet, you could return the dryer-outlet air to the heated space. Some experts have suggested, however, that very small fibers can pass through even fine filters and lodge deep in an occupant's lungs.*

## Add-a-duct debate

It is my understanding that supplying outdoor air to a furnace increases its efficiency. Is this contrary to your answer in Add a Duct? in the January "AEA" column?

Robert J. Currie, Chicago, Ill.

You state in Add a Duct? that combustion air will be heated directly or indirectly if outdoor or indoor air is used for combustion. But because the flame is a result of a chemical reaction, wouldn't the flame be the same temperature regardless of the air-supply temperature?

Thomas M. McCain, Canandensis, Pa.

*A chemical reaction produces heat, not temperature. A given Btu number is released per pound of fuel burned (let's assume complete combustion for simplicity). Therefore, if colder air enters the combustion chamber, the effective flame temperature will be lower. There is another factor at work in some cases. Cold air is more dense and contains more oxygen than does warm air. This can improve combustion efficiency when the furnace is tuned (i.e., set for an air-fuel ratio) for cold air. It will then have best efficiency with an outdoor air supply.*

## High R-value desire

I want to build an energy-efficient house with walls that have an insulation value of R-40 and a roof with cathedral ceiling of R-60. What sort of insulation can I use without having thick walls and roof?

Sybil Volkman, Boise, Idaho

*I question the need for insulation values of R-40 and R-60. When you look at the cost of this large amount of insulation and the expensive floor space the thick walls consume, it may not be cost effective. If you decide to proceed as you describe, the highest R-value insulation commonly available is polyisocyanurate. One company's trademark is Thermax. It has an R-value of about 7.5 per inch. Therefore, with 2×6 wall construction (5.5-inch true cavity depth), you will have R-41 due to the insulation alone.*

## Crawl-space-plenum problem

My wood-framed crawl space serves as the hot-air-supply plenum for my house. The walls of the crawl space are insulated, but the floor is not. Should it be?

Robert N. Schneblin, Elko, Nev.

*I can't imagine why you would use a crawl space as a supply plenum for a heating system. The leaks of hot air through your wood walls must be costly. Rather than insulate the floor of the crawl space, I would install a duct system with proper insulation. You should have an engineer or competent contractor check the size of your present furnace fan relative to the required duct system. The savings from this will be very large relative to those from floor insulation.*

## Preventing pipe corrosion

Why hasn't someone come up with a simple, homeowner-installed active anti-corrosion device for home plumbing systems instead of the passive magnesium-anode approach? My water is acidic, and the copper cold-water pipes corrode and leak.

Frederick Butterfield
Williamstown, N.J.

*Water chemistry is a complicated matter. It may be a metallic ion that is causing your problem. If your water is acidic, many ions probably are present in the city water. I suggest a thorough water-chemistry test with advice from an expert regarding corrosion control. Cathodic protection of buried pipes is accomplished in remote locations by use of solar-cell arrays. The array is designed to produce a voltage in the opposite direction of and greater than the natural galvanic voltage. This method of corrosion control could be applied to home water heaters in theory, but the cost would be many times greater than that of replaceable magnesium anodes.*

Do you have a question concerning use of an alternate energy such as solar, wind, water, or wood? Wondering about energy-conservation techniques for home heating or cooling? Every other month Jan Kreider answers selected questions from readers. Send yours to Energy Questions, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Queries can't be answered by mail.



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# M I T S U B I S H I

## News for those who take their fun seriously.

If you take your fun seriously, you'll be pleased to know that we feel the same way about building trucks. And to prove it, we proudly introduce the all-new Mitsubishi Mighty Max pickup.

This new Mitsubishi is more than just a compact truck. It's a new idea in trucks, patiently crafted to put fun and value back in the fundamentals.

Consider its vigorous new shape, aerodynamic contours and wide aggressive stance. Mighty Max is built to play as hard or easy as you like. With an efficient 2.0-liter engine, a rugged double-wall cargo box, 5-speed manual overdrive transmission and independent front suspension. Even power assist front disc brakes and radial tires are standard.

And with Mighty Max, the fun isn't just on the outside. Inside you'll find an all-new interior ergonomically designed for functional efficiency and comfort: Including a roomy sport bench seat, headrests, full carpeting, tinted glass and a tilt steering column.

The new Mitsubishi Mighty Max pickup. At **$6289**,* it's serious fun for the money.

Patiently engineered to let you carry it all... or just plain carry on.

*Mfrs. Suggested Retail Price. Taxes, license, freight, options, other dealer charges extra. Rear bumper and bodyside molding optional.
Call 1-800-447-4700 for your nearest dealer.

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MITSUBISHI MOTORS

# NEW MIGHTY MAX

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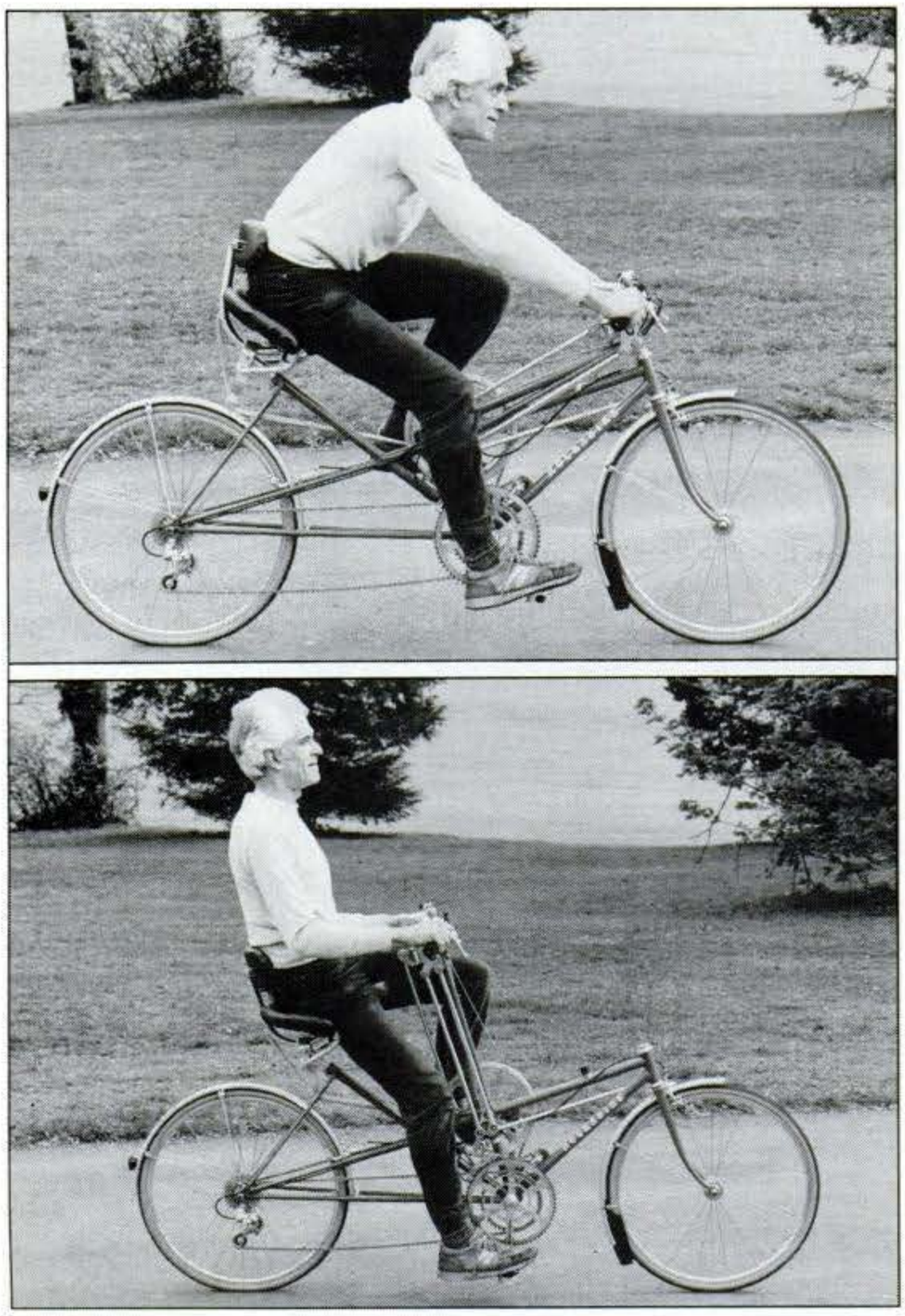
# What's New
## *products/technology*

BY DAWN STOVER

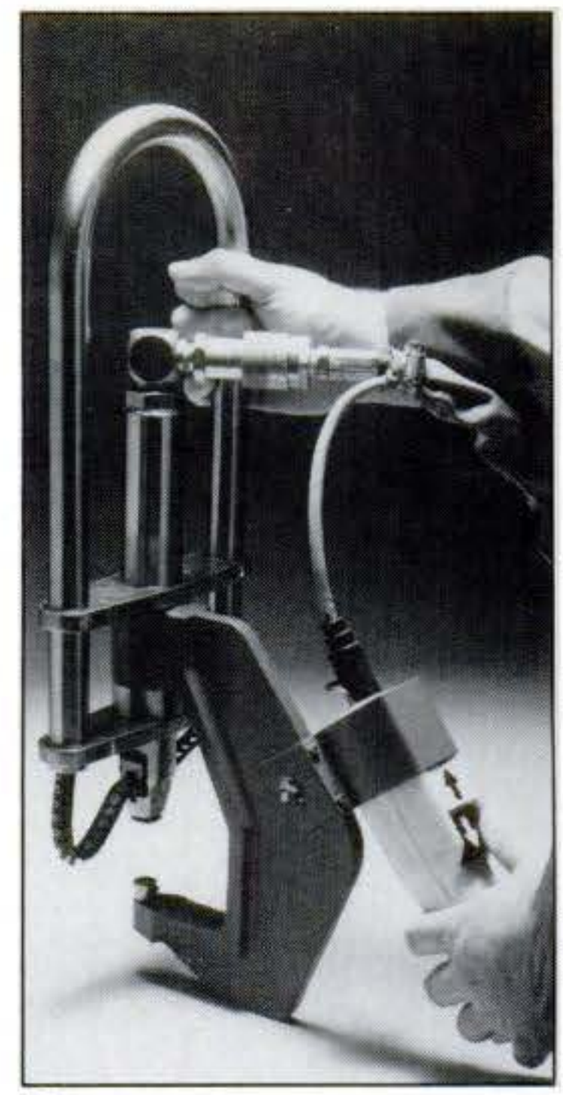


### Row your bike

**Pump Rockabike's handlebars for more speed and less leg effort. The handles are linked to the derailleur with a ratchet and to the front wheel with steering levers. It mimics a running animal's motions, says Rockabike (95 Lawrie Park Gardens, London SE26 6HW, England).**

### Electronic leash

**Keep an ear on your child with a receiver that clips to your belt. It sounds a beeping alarm when the child's transmitter is 20 to 30 ft. away, or if it contacts water. The Nanny is $32.70 from M.A. Bedol Catalogue (1768 Fillmore Dr., Monterey Park, Calif. 91754).**

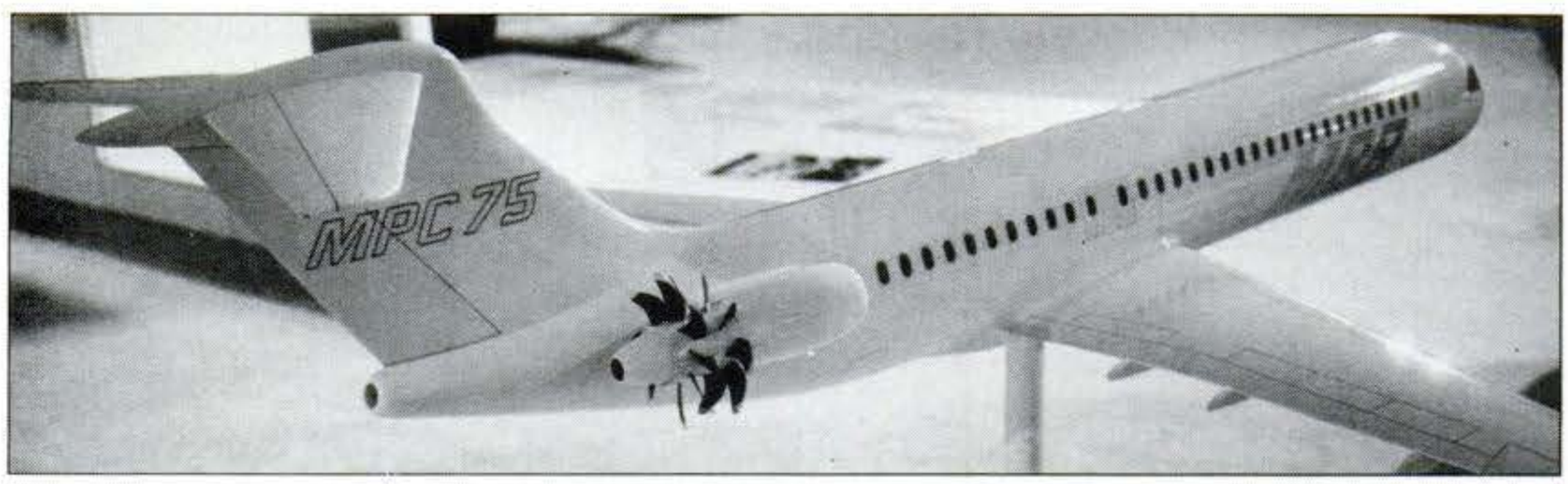


### Rivet setter

**Self-piercing rivets feed and punch holes in less than 5 sec. There's no need for predrilling or aligning holes, or retouching coated material. The portable system is $7,000 with hydraulic power pack. Michael David, 12 Cardigan Close, Dinas Powys, S. Glam. CF6 4PL, Wales.**

### Three-way scope

**Edmund Scientific's three-in-one optics works as a 5× telescope, 10× magnifying glass, or 40× microscope. Precision-coated glass optics improve image clarity. The 3-by-1-in. scope is $40. Edmund Scientific, 101 E. Gloucester Pike, Barrington, N.J. 08007.**




### Fan fare

**Two unducted fans will propel a 60- to 80-seat airliner being jointly developed by the Chinese Ministry of Aviation and the West German MBB Transport Aircraft Group. The low-wing MPC 75 will cruise at 35,000 ft. at about 400 mph. It's expected to be ready in 1995.**

### Roomy mini-car

**Wheels placed near each corner form a 97-in. wheelbase, so you can stretch out in Orbit's four bucket seats. Gull-wing doors on the 56-in.-high car provide access to front and back seats. From Italy's Ital Design, it's based on a Volkswagen Golf and isn't for sale yet.**



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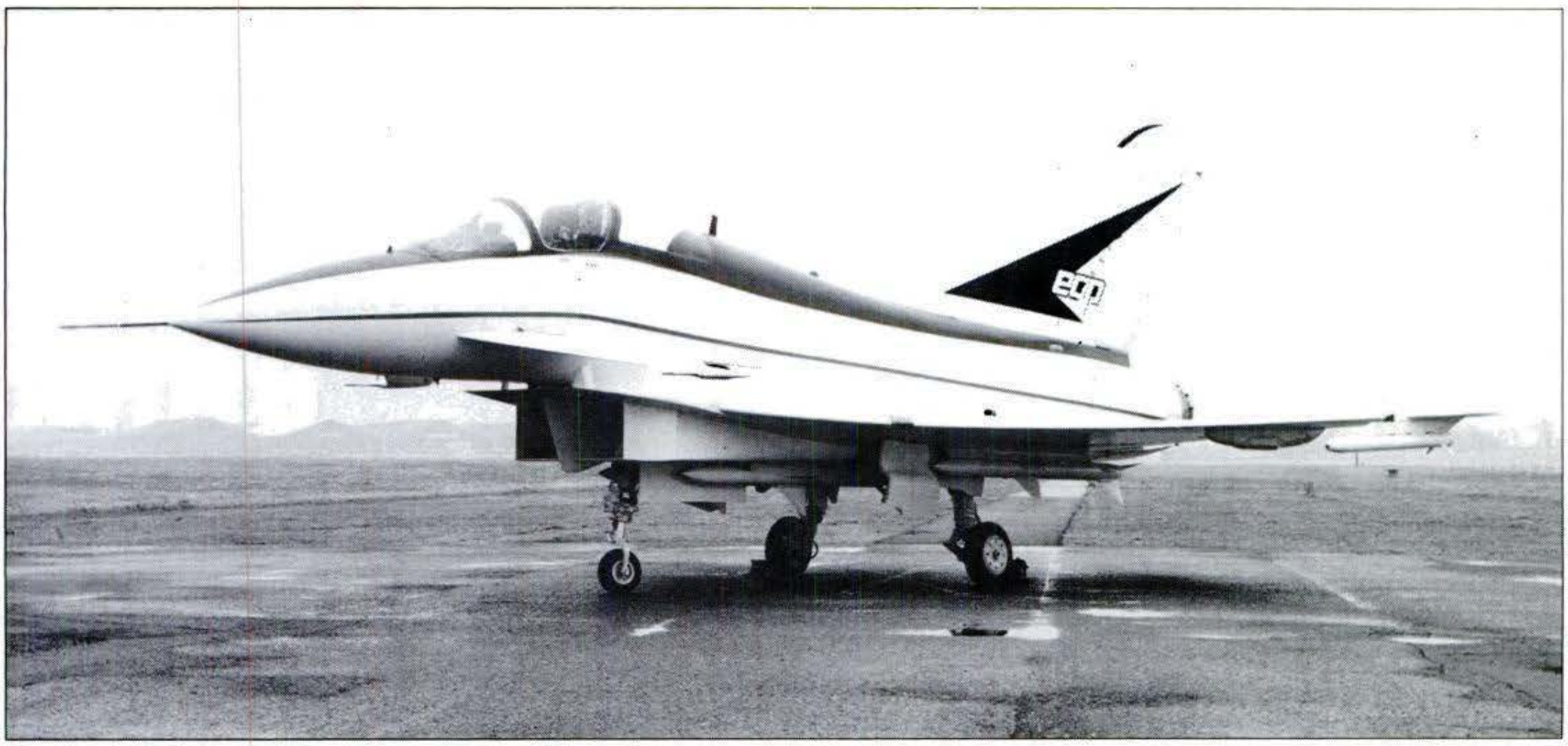


## Agile aircraft

Europe's EAP—Experimental Aircraft Programme—demonstrator is a British-West German-Italian high-tech fighter plane designed to test advanced concepts. The single-seater, with moving canards and compound-sweep wings, is powered by twin RB199 engines.

## Tapless bathroom

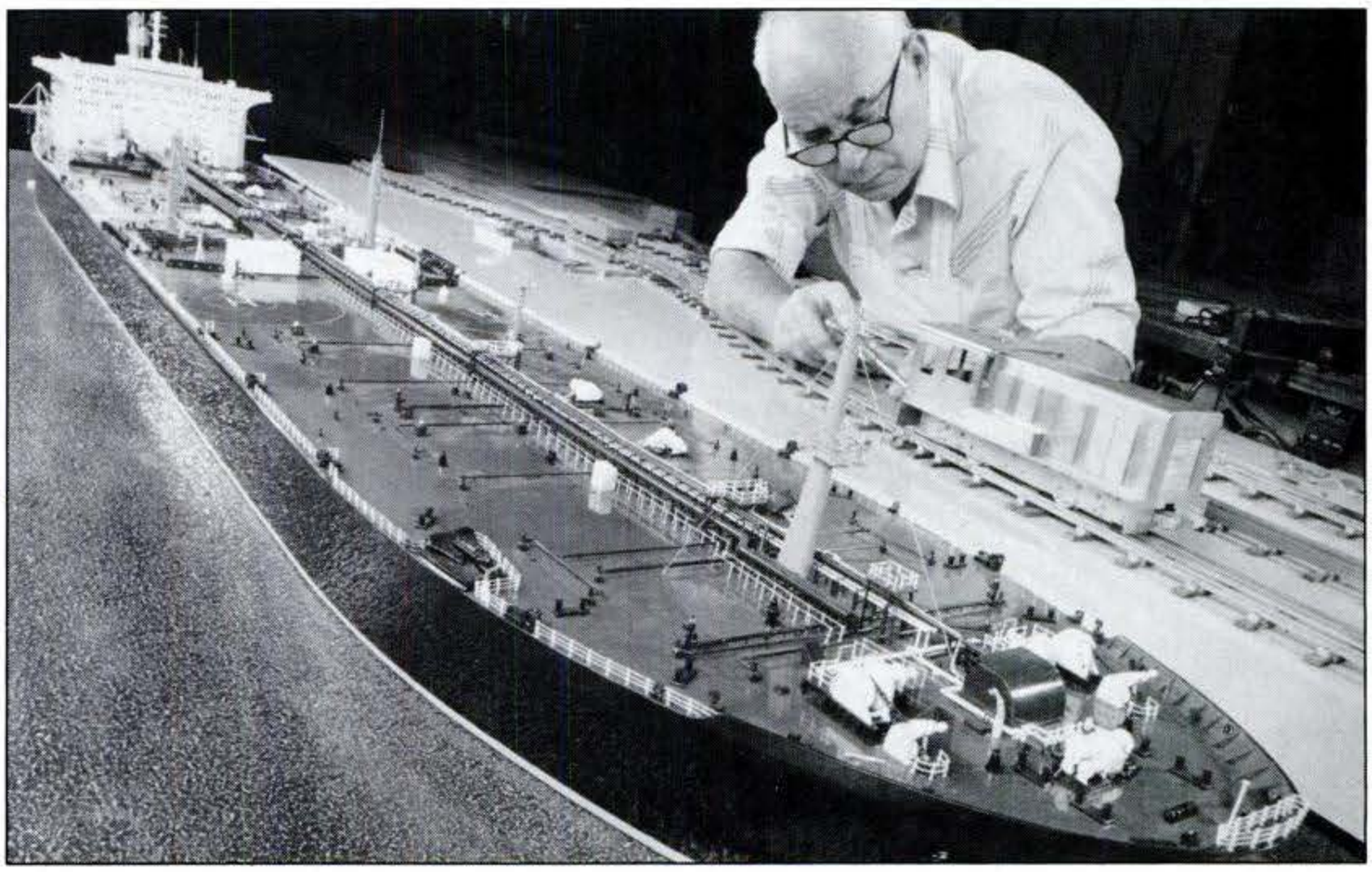
You push buttons to control water flow with this computerized plumbing. A remote-control unit (inset) provides hot or cold "top-ups." Microprocessor and motor-driven mixing valves can control all fixtures. From Walker Crosweller (England), installations cost up to $3,750.

## Two gal./hr.

Plus 5 oz. of two-stroke oil. That's all the fuel you burn flying the all-wood miniMAX ultralight, claims its maker. The plane uses the Austrian-built Rotax 277 engine. A kit is $3,175, not including paint and instruments. Plans cost $125. TEAM, Rte. 1, Box 338C, Bradyville, Tenn. 37026.

## Design aids

An artist develops a miniature replica of a new Singapore railway that will help train drivers, signalmen, and platform staff. The tanker is also one of many models built by Britain's Bassett-Lowke Ltd. over 80 years to aid designers and avoid costly construction mistakes.





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# What's New *in Photography*

BY ARTHUR FISHER

## Pop-up flash

Two recent entries in Kodak's line of inexpensive 35-mm cameras are this model K40 and a more sophisticated K60. Both are automatic and have fixed-focus lenses. The K60's flash automatically turns itself on and off. Prices: $83 for the f/5.6 K40, $93 for the f/4.5 K60.

## Versatile compact 35-mm duo

From Vivitar, here are two compact automatic 35s that cover a wide range of possibilities. The "all-terrain" Trek 50 (top) has a waterproof, rubber-armored exterior and is submersible to 10 ft. A switch provides macro focusing to 3 ft. With a fixed-focus f/5.6 lens, it's $218. The TW 35 ($210) has a dual-lens system that uses a pivoting mirror rather than moving lens elements, allowing the choice of a 35-mm f/5.6 or 80-mm f/8 lens for wide (fixed-focus) or tele (autofocus) shots. A focal-plane shutter provides speeds up to 1/2,000 sec. Both models have built-in flash.

## Princely projector

Everything a 2¼×2¼ (6×6) format photographer could ask for, this $2,000 Hasselblad PCP80 automatic slide projector has a unique feature: a perspective control that eliminates keystoning when raising or lowering the lens to fill the screen. The round tray holds 80 slides.

## Titanium SLR

The multi-spot-metering Olympus OM-4 is now also available clad with a tough, lightweight titanium body as the OM-4T. Special circuitry enables its use with the new Full-Synchro Flash System for flash speeds as fast as 1/2,000 sec. The OM-4T is $770; the flash costs $210.



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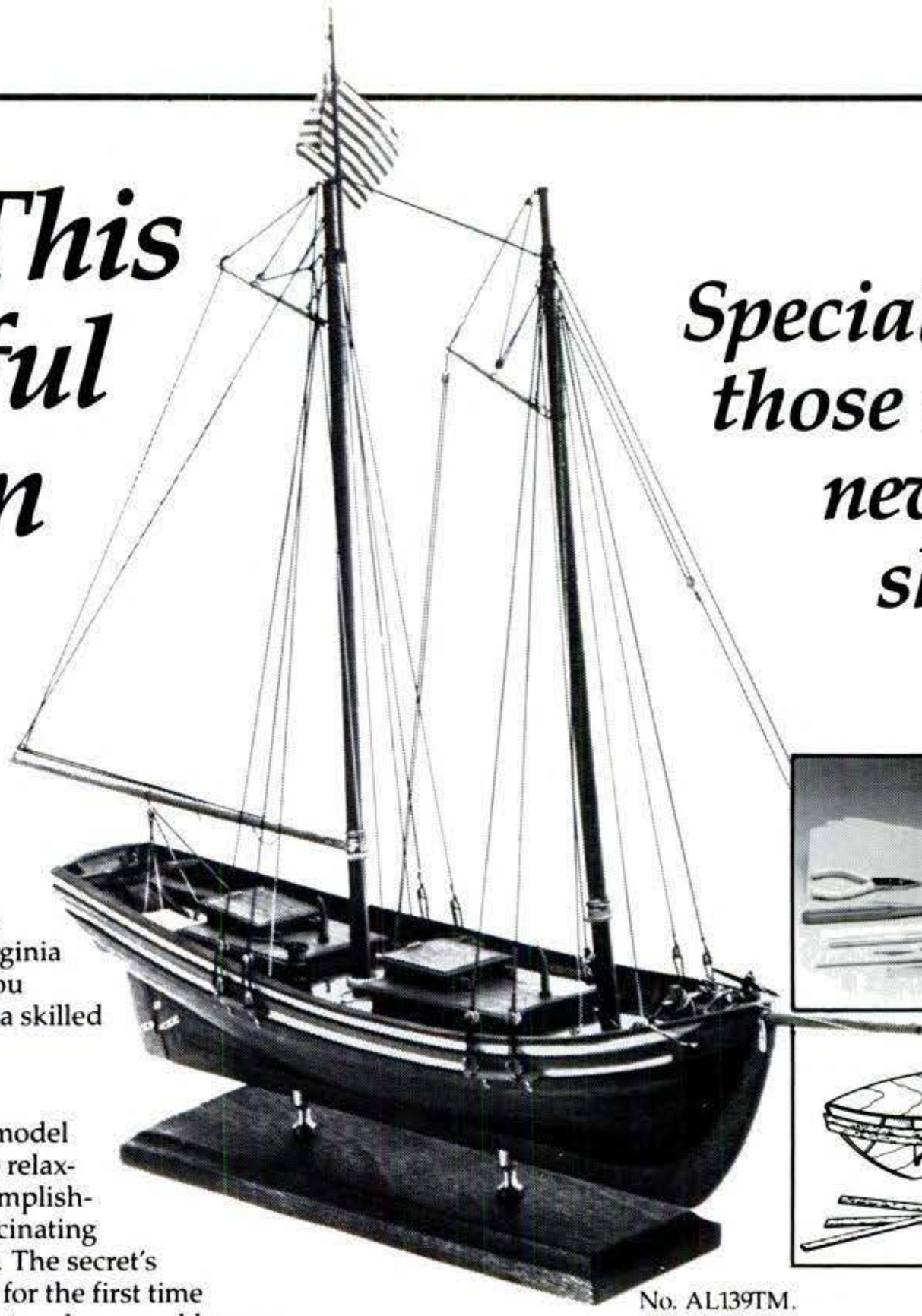
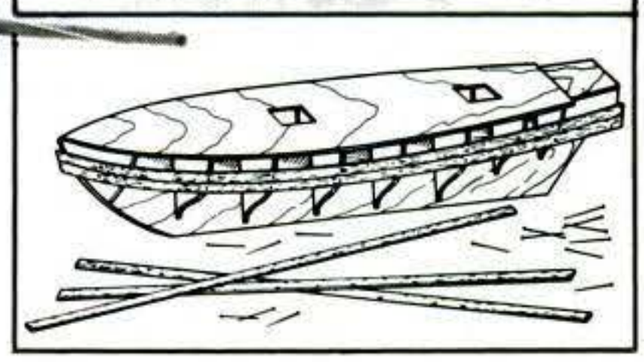
# *Build This Beautiful Wooden Ship Model*



## *Special Offer for those who have never built a ship model before!*



No. AL139TM.

Wouldn't you love to build this historic ship model? It's a true-to-scale, 21" replica of the 2-masted schooner *Swift*, a Virginia pilot boat of 1805. Well, now you can! And you don't have to be a skilled craftsman to do so.

**It really isn't hard**

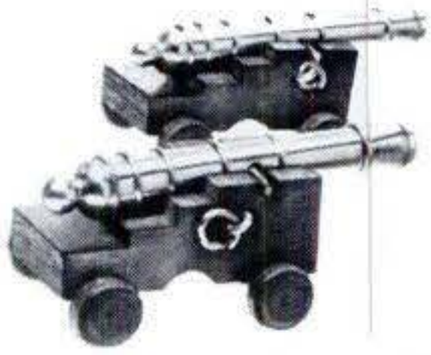
Even if you've never built a model before, you can experience the relaxing pleasure and pride of accomplishment that is offered by this fascinating hobby. You can build the *Swift*. The secret's in our kit, designed especially for the first time modeler, with pre-cut parts that make assembly easy. Clear, large scale plans and instructions that virtually take you by the hand and guide you every step of the way through hours of the most relaxing fun you'll ever have. And when completed – a museum quality model you'll display with pride, with gleaming brass fittings, walnut planked hull, delicate rigging – lifelike in every detail.

**Quality you can see and feel**

The materials in our kit may be better than those used in the original *Swift*. The keel section and frames are pre-cut plywood, ready for quick assembly. The *Swift's* hull is planked twice; once with thick, flexible limewood for strength, then overlaid with planks of African walnut for lasting beauty.

You don't have to make the fittings – we've done that for you. Our kit contains ready-to-use blocks and deadeyes of rare, yellow boxwood. We include eyelets, bracers and belaying pins – over 70 parts of solid brass! Even the cabin door hinges are brass, as are the 250 miniature nails you'll use to fasten the planking to the hull and deck. And, since the original wooden *Swift* had no plastic parts, our kit doesn't either – anywhere!

Creative? And how! Overwhelming? Not a bit! But be prepared for hours of the most challenging, engrossing, relaxing fun you've ever had.

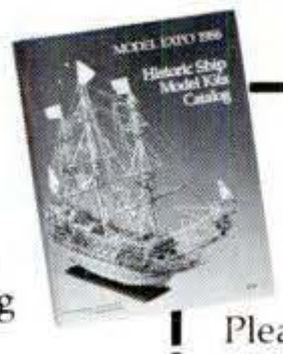


**Miniature Cannon Kit Bonus!**
Set of two solid brass cannon on walnut carriages to be mounted amidship. $4.00 value, sent FREE with your order.

**An "everything you'll need" special offer, with free tools and handbook.**

We want to introduce you to this great hobby, now! So we've made it easy for you to get started. Our special offer includes the *Swift* kit plus all the tools you'll need to build her: pliers, hammer, knife, file, tweezers, sandpaper, glue, wood oil, and more. You'll also receive a free copy of "Ship Models from Kits," a 110 page beginner's guide. You don't have to buy anything else. The tools normally cost $17; the book retails for $7.95. But they're yours, FREE when you buy the *Swift* kit at its regular low price of $29.95 (plus $3.00 for delivery).

**Credit card holders order toll-free.** Call **800-228-2028**, ext. **68**, 24 hours a day. In Nebraska, call 800-642-8300. Or use coupon below to send check or money order. **Order kit No. AL139TM.**



64 page full color ship model catalog sent FREE with your order.

PS-116

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Address _____

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If less than delighted, you may return your purchase within 30 days for a full refund.

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# What's New *for Your Car*

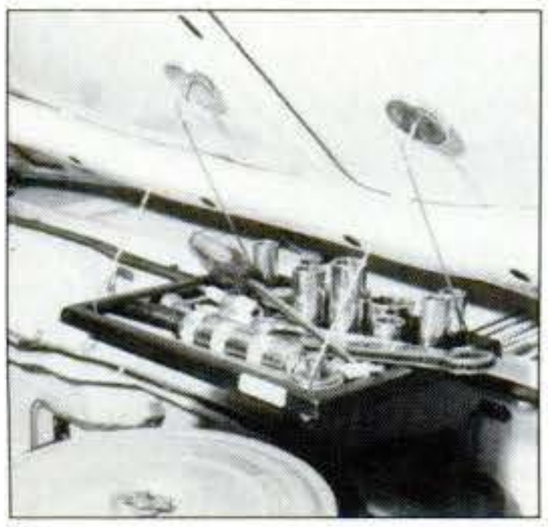
BY JACK KEEBLER

## Seat-belt comfort

**Designed to wrap around the seat-belt shoulder strap, the Belt Bra is made of a soft material that spreads the tug of the strap over a wider area to improve driving comfort. Available in black, it costs $7 and is made by ANB (Box 994, Montebello, Calif. 90640).**

## LCD analyzer

**The model 365's inductive pickup clamps to engines to measure rpm, dwell, volts, and ohms. The maker says the large LCD display is easier to read in low light than the needle-type meters. Electro-Specialties (680 Bonnie Lane, Elk Grove Village, Ill. 60007). Price: $115.**



## Driving computer

**The $389 VC200 sits on the dash and plugs into the lighter to measure acceleration, braking distance, horsepower, torque, and lateral grip. All the sensors are internal, so there are no additional hookups. Maker: Vericom Corp., 6000 Culligan Way, Minnetonka, Minn. 55345.**

## Lug-lock wheel

**The BBS center lock design has a patented plate that covers the lug bolts and hub to protect the wheel from theft. Cross-spoke design comes in gold, silver, or black. The wheel costs $245 –$380; BBS of America (33 Murray Hill Dr., Spring Valley, N.Y. 10977).**

## Magnetic tool tray

**Powerful magnets attach the Tool Partner to the inside of the vehicle's hood, providing a sturdy shelf that will hold enough tools for most repairs. The tray ($10) is covered with a plastic that resists auto chemicals. SM Products, 7928 Bacadi Dr., San Diego, Calif. 92126.**

## Bed cover plus

**Made of extruded aluminum and steel, Versa-Cover comes in several sizes for securing the pickup bed and reducing overall wind resistance. The roll-top retractable cover slides into the toolbox, which stores small items. Leer, 58288 Ventura Dr., Elkhart, Ind. 46517; $399.**

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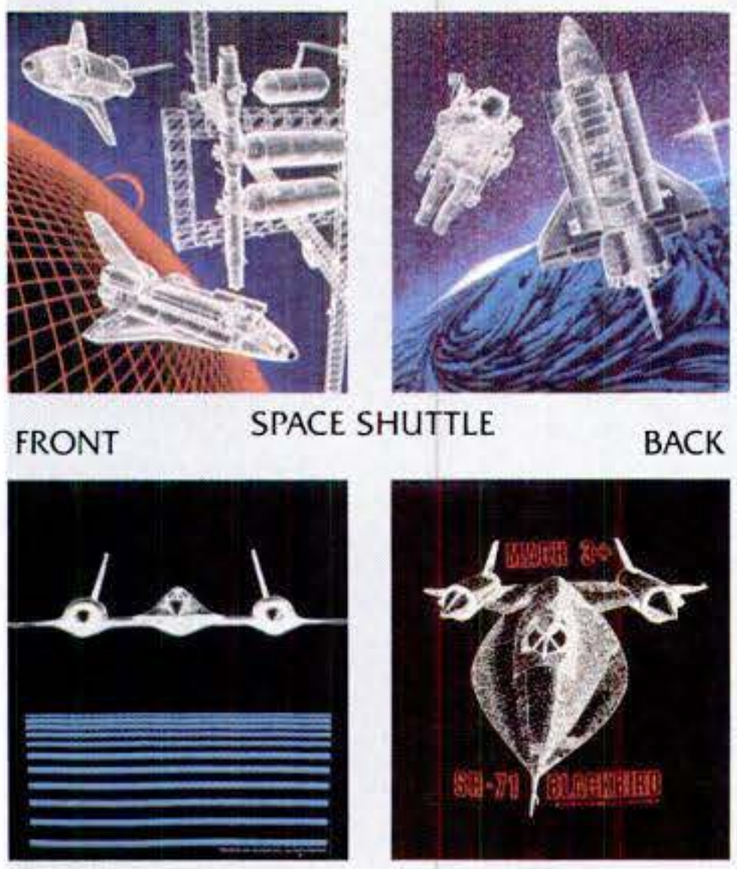
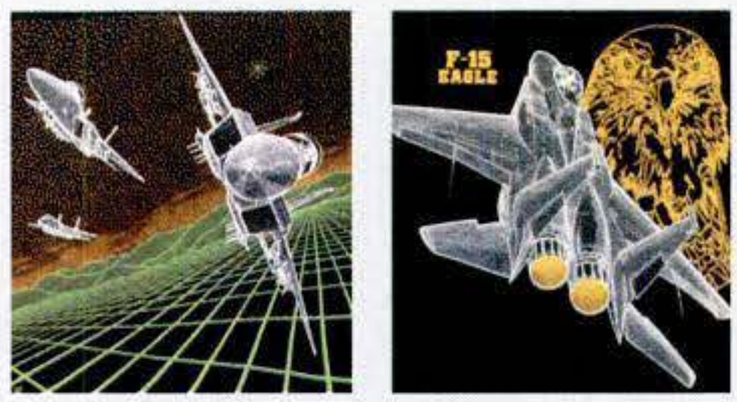


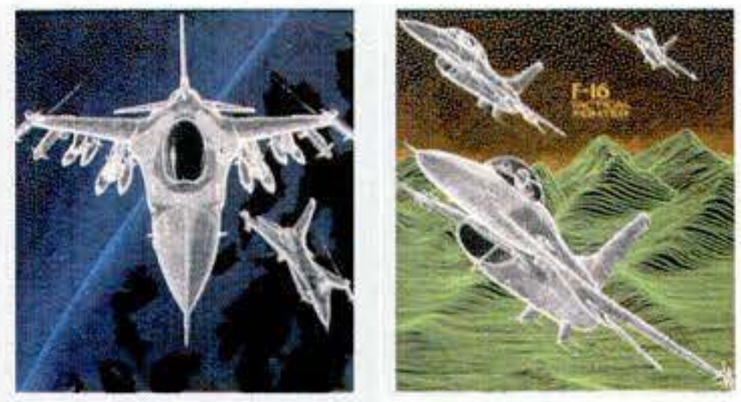
FRONT SPACE SHUTTLE BACK

SR-71 BLACKBIRD NO. 1



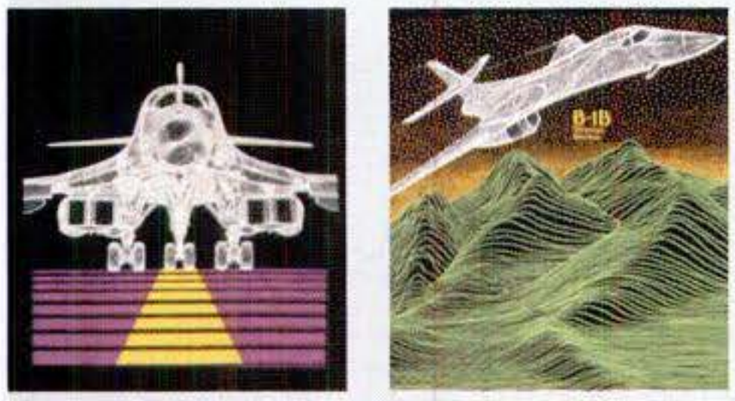

FRONT BACK

F-15 EAGLE

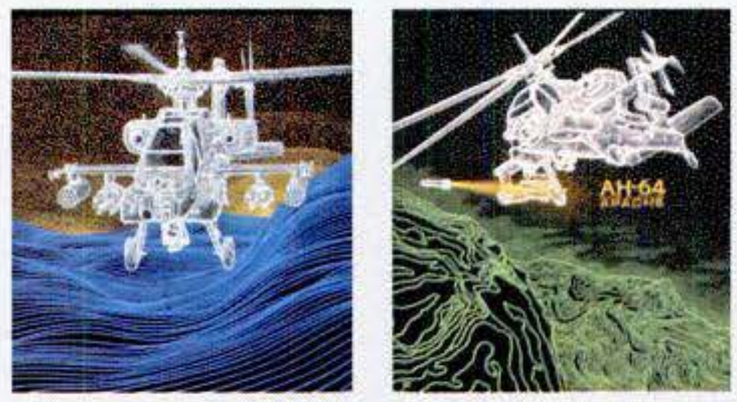


FRONT BACK

F-16 TACTICAL FIGHTER

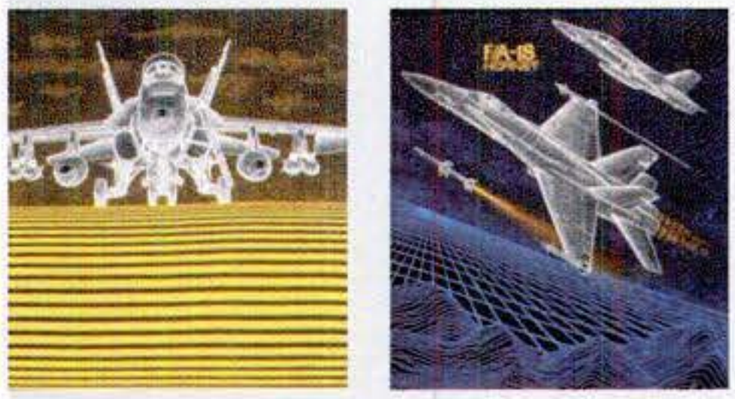



B-1B STRATEGIC BOMBER

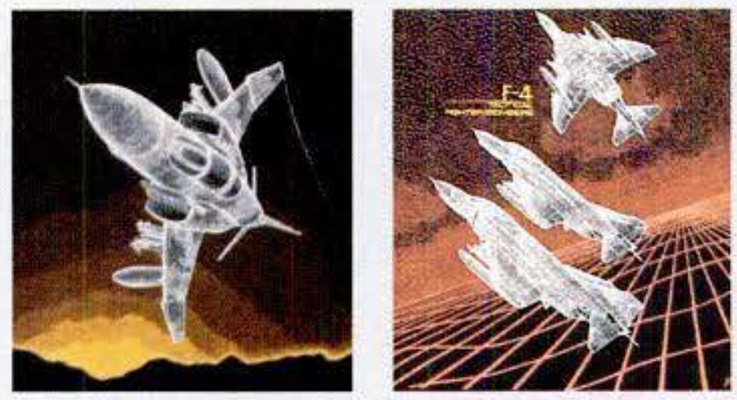



AH-64 APACHE

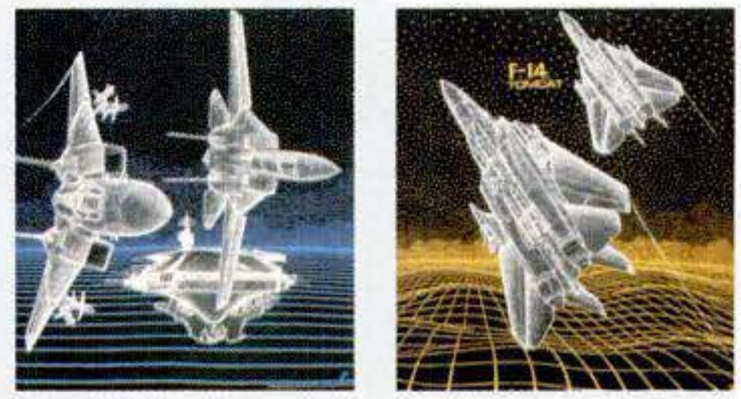
F-20 TIGERSHARK




F-18 HORNET




F-4 TACTICAL FIGHTER/BOMBER

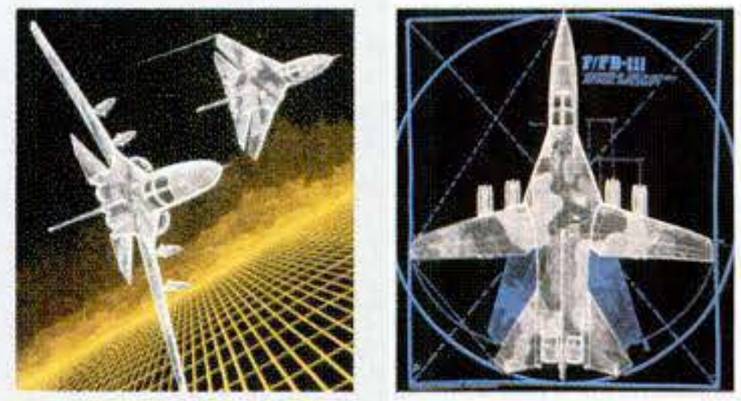



F-14 TOMCAT

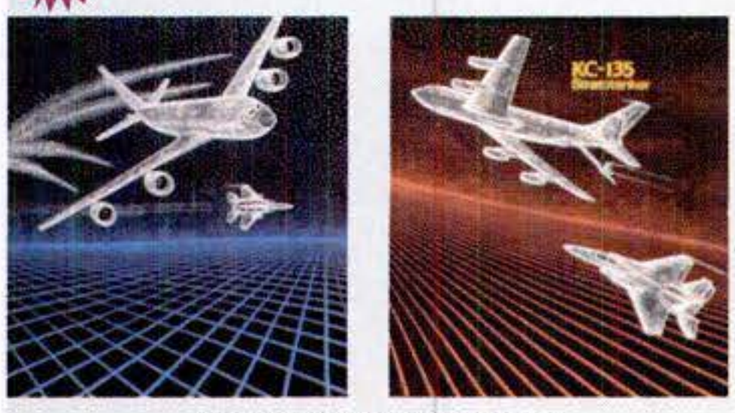
NEW

A-10 THUNDERBOLT

HARRIER



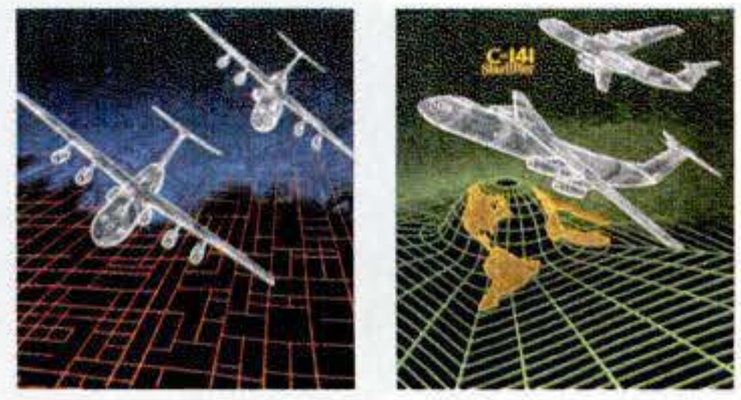

F/FB-111 FIGHTER/BOMBER




KC-135 STRATOTANKER

(actual shirt photos)

C-130 HERCULES




C-141 STARLIFTER

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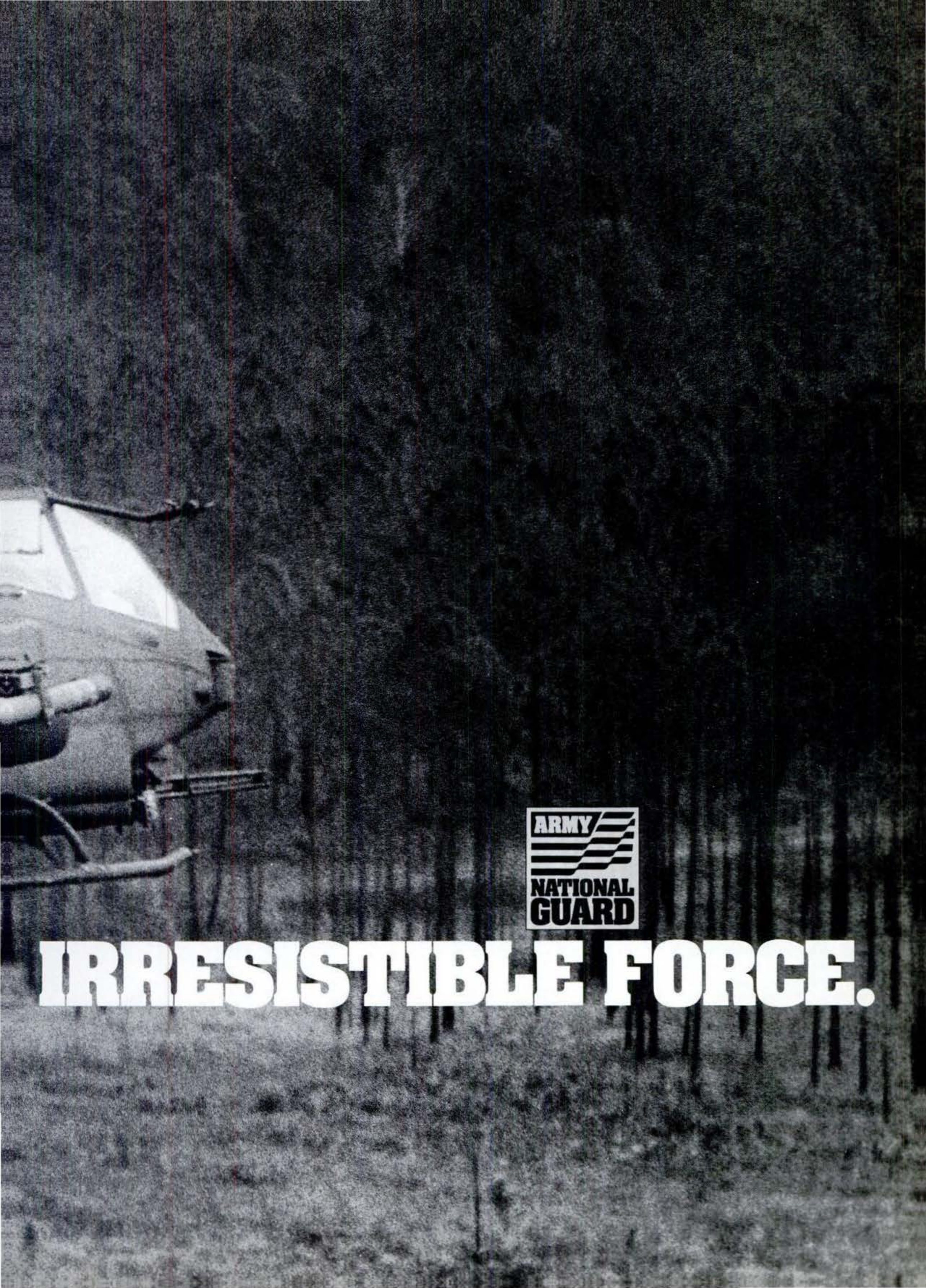
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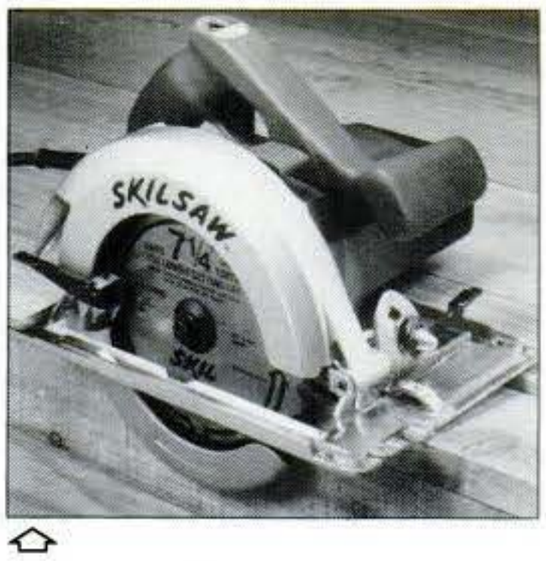
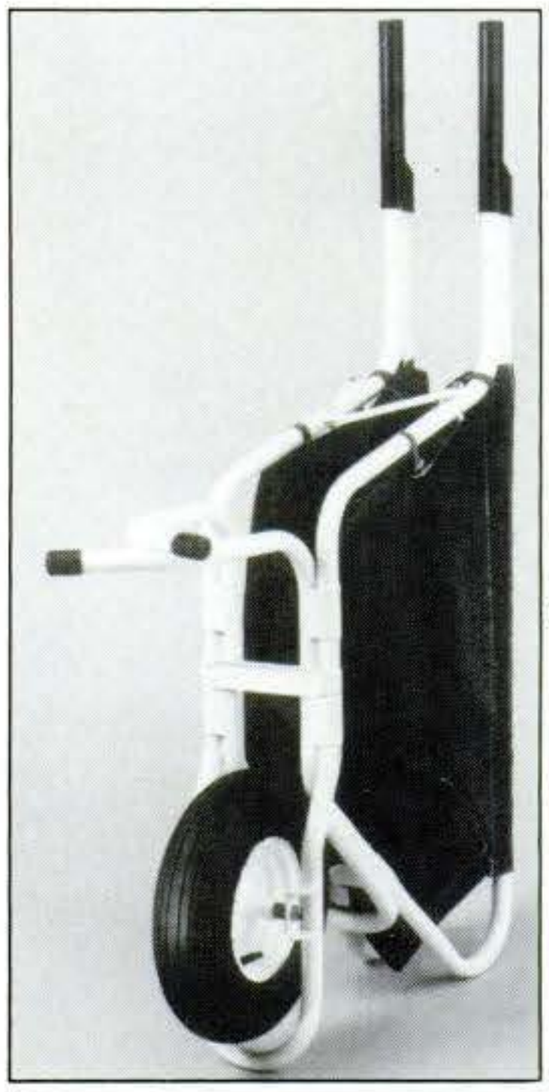
# What's New *in Tools*

BY V. ELAINE GILMORE




## Pro cutter

**Make a plunge cut with a circular saw, and the bottom guard may get in your way. But not with Skil Corp.'s coming model 5656: You can raise its guard with a handy lever. The pro saw's 13-amp motor produces 5,400 rpm; its 10-ft. cord reduces hang-ups. It will cost about $130.**

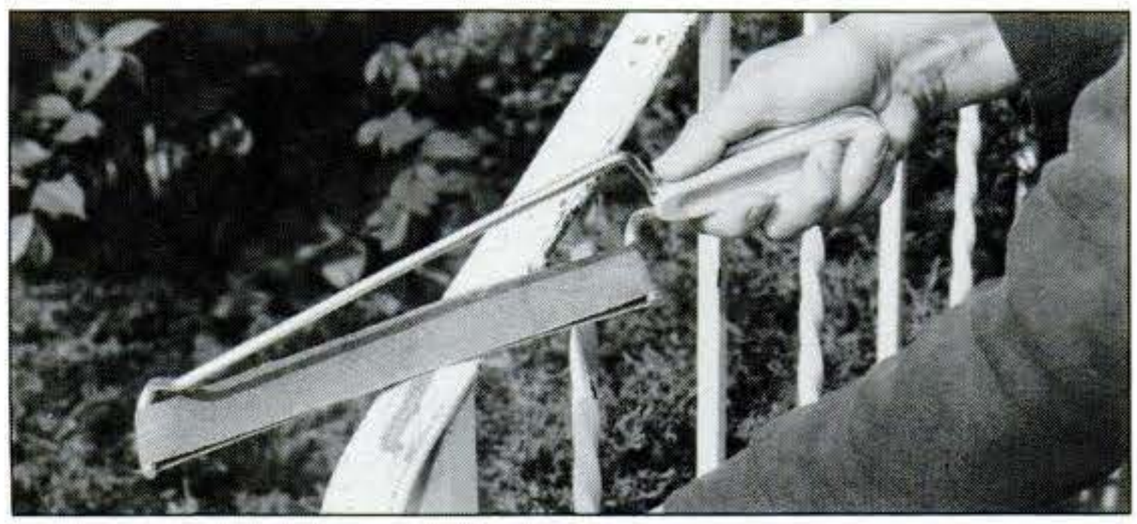


## Fold-barrow

**How do you store a bulky cart? With the Dutch-made Umbrella wheelbarrow the problem is reduced—to 7½ in. (its width when folded). When unfolded, its polypropylene tub holds a 300-lb. load. Exaco USA, 1 Rockefeller Plaza, New York, N.Y. 10020. Umbrella costs $59.**

## Roller-matic

**What's as convenient as a power paint roller but much cheaper? A roller with a long, fat handle that doubles as a paint reservoir. To suck in paint, you push the fill valve onto a tube on the paint-can lid (inset) and pull up on the handle. To feed the roller you give the handle a nudge. Power-Flo (1661 94th Lane N.E., Minneapolis, Minn. 55434), Wagner (1770 Fernbrook Lane, Minneapolis, Minn. 55441), and Sears offer these ingenious painters. The Sears (shown) and Power-Flo models, called Paint Sticks, hold 18 oz. of paint. Wagner's Handi-Roller holds 26 oz. All are around $30.**



## Slack sander

**Sandbow is a hand sander designed for curves and edges. A 2½-by-20-in. belt fits on its steel frame with enough slack to let it follow curves—on wood, metal, or ceramics. The sander is $9; spare belts (in 60-, 100-, and 150-grits) are 2 for $3. Glit Inc., Box 709, Wrens, Ga. 30833.**

## Mill on the spot

**The $2,450 Lumber Company is a portable sawmill that converts trees—where they fall—to dimensioned lumber. And it rotates to become a vertical band saw for edging and resawing. The thin blade wastes little lumber, notes Delta Intl. (246 Alpha Dr., Pittsburgh, Pa. 15238).**

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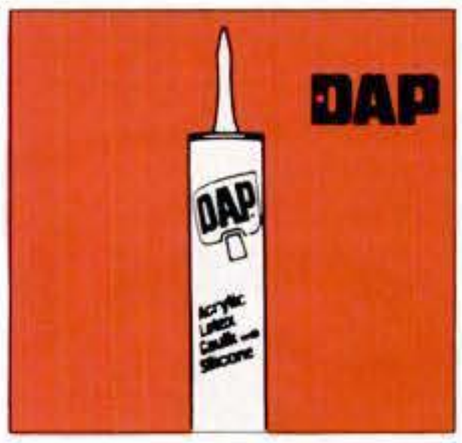


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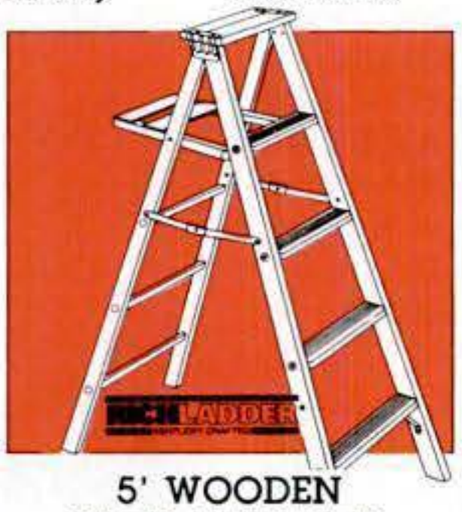


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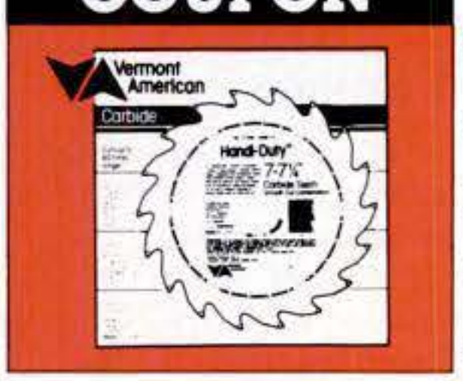


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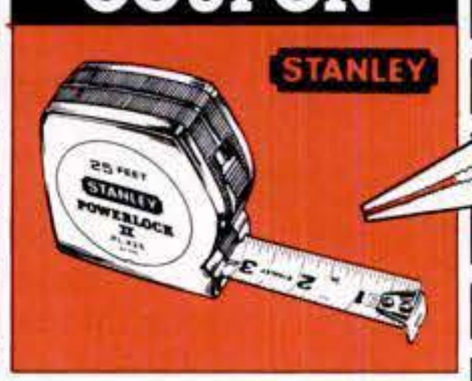


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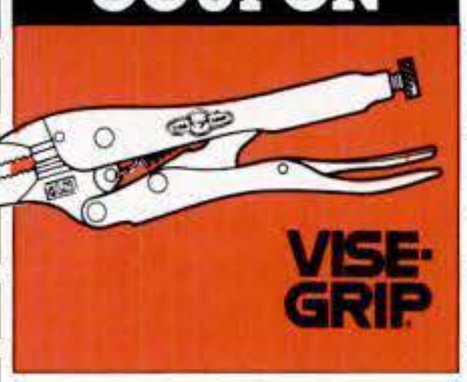


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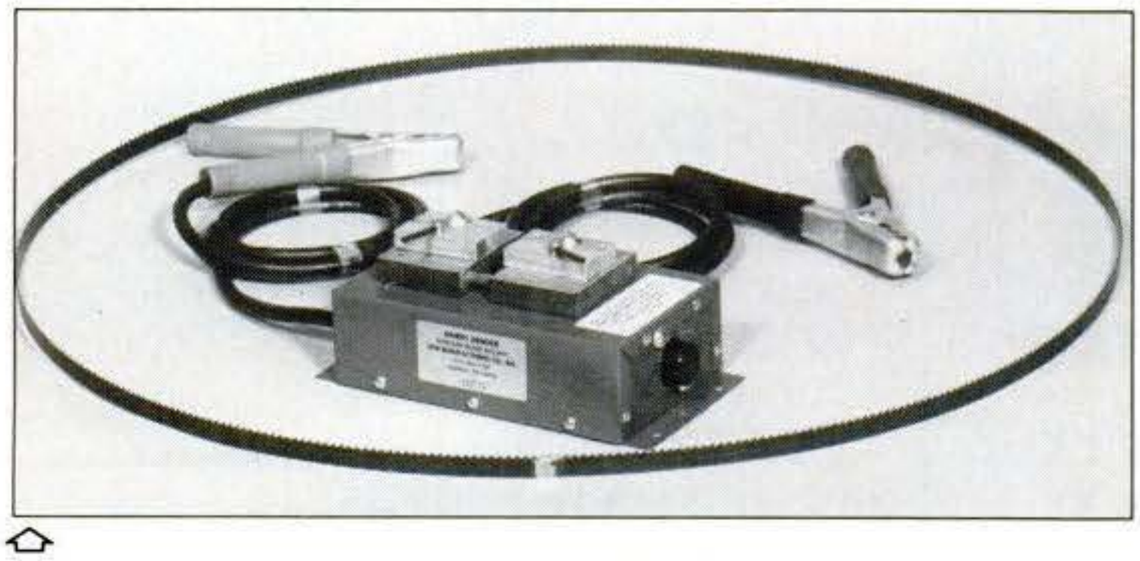
# What's New *in Tools*

*Continued*

## Slurper vac

Now you can clean up wet messes as well as dry ones with a cordless hand vacuum cleaner. The Sears Wet/Dry vac holds 8 oz. of liquid and runs for 15 min. on a charge, the retailer claims. The $40 machine comes with a nozzle, squeegee insert, filter, and recharging base.

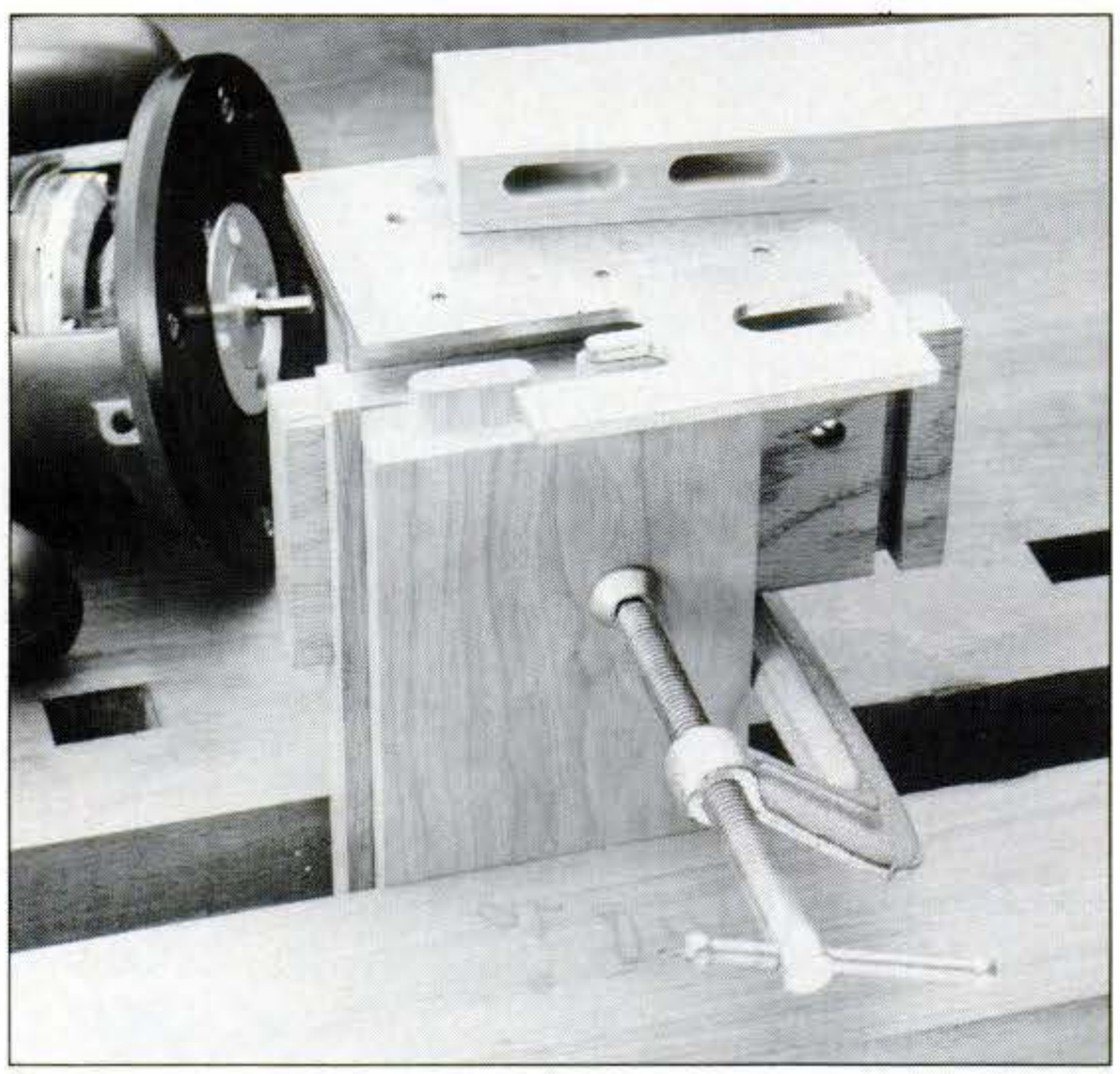


## Blade unbuster

Clamp the ends of a broken band-saw blade together, attach the alligator clips to a garden-tractor battery, and push the weld switch. In seconds the ends are welded. You can also make new blades from bulk stock. Bandit Bander is $50. RPM Mfg., Box 1782, Appleton, Wis. 54913.

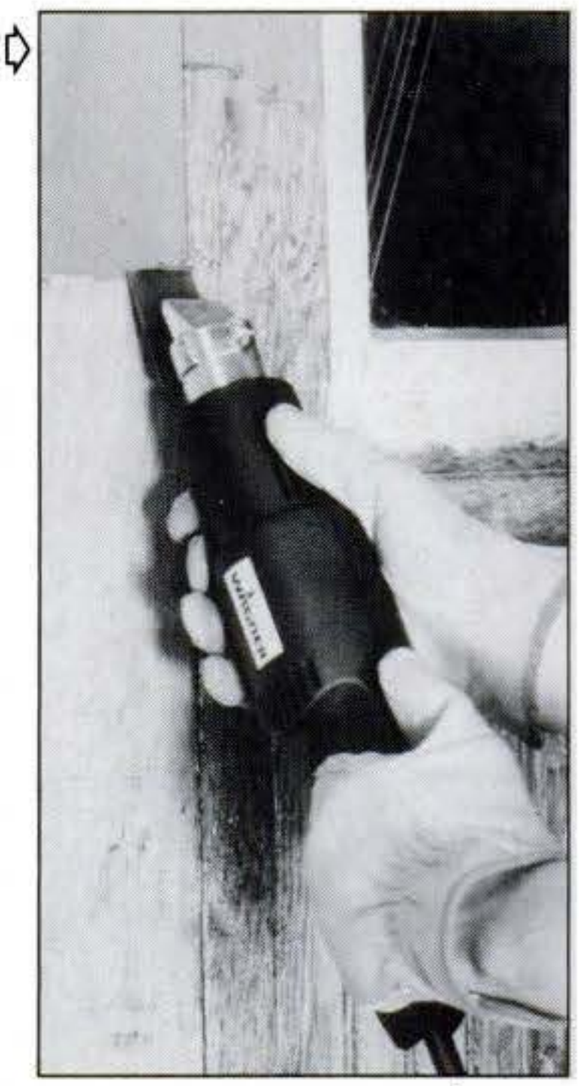
## Mighty mixer

With your electric drill and Multimixer you can mix 1 cu. ft. of concrete in a minute—equal to turning 1,800 shovelloads, it's claimed. The drill turns a modified Archimedean screw, which slides and rotates on a cross bar. Swordfish Systems, Styal Rd., Manchester M22 5WB, England.



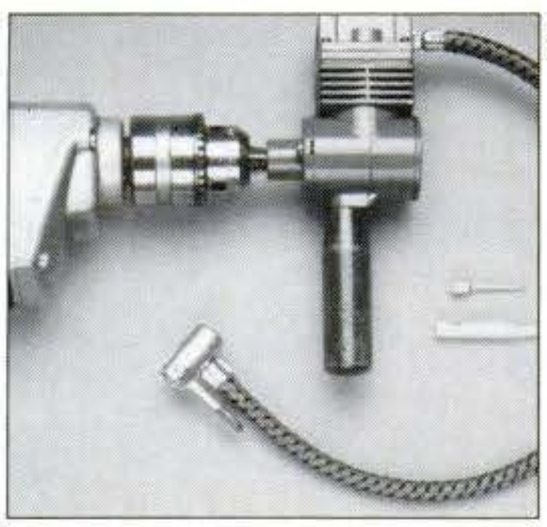
## Guns and knives

With Wagner's Hot Scraper heat gun you don't need a putty knife to remove blistered paint. It comes with integral blades: one for scraping and one for "pulling" off the paint. Temperatures: 600° and 1,100° F. Wagner says the scraper will sell for $60.



## Great joints

A router becomes a mortise-and-tenon tool when you team it with this jig. You cut one side of a tenon with the jig placed as shown, then flip it to cut the other side. Pins ensure precise lineup. The oval guide is for mortises. Woodcraft Supply, Box 4000, Woburn, Mass. 01888; $51.50.



## Drill blow-up

If you harness your electric drill to the Power Air Pump, a mini-compressor, you can inflate toys, balls, tires—anything up to 90 psi. Made by General Hardware Mfg. Co. (80 White St., New York, N.Y. 10013), it is available in stores for about $30. Price includes two nozzle adapters.



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New Jeep Comanche SporTruck

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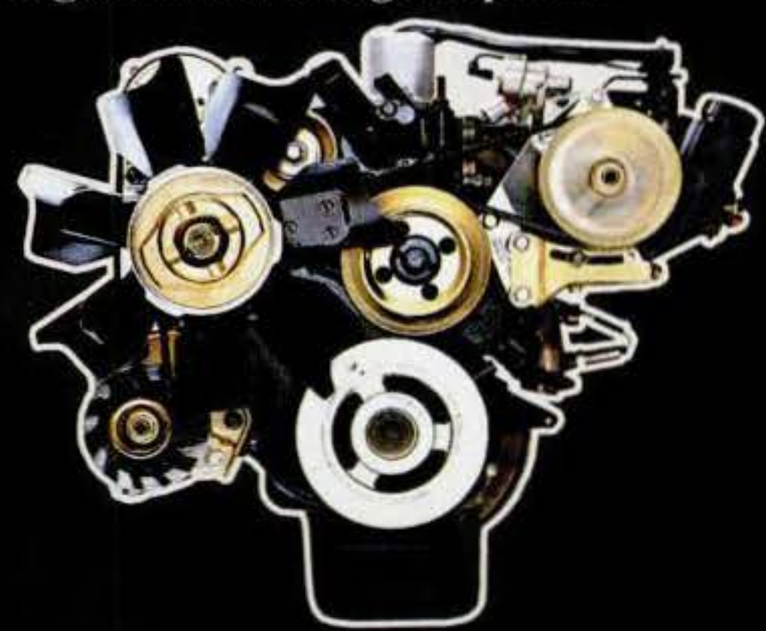
1987 COMANCHE SPORTRUCK: It's not only the newest 2-wheel drive Comanche pickup, it's also the most affordable vehicle Jeep builds. At just $6,495, SporTruck has the most powerful standard engine of any truck in its class... delivering an impressive 121 horsepower. Plus, it's the only vehicle in its class with big 15-inch wheels and tires, standard.

POWER: This year, Comanche comes with an all-new optional 4.0 litre *Power-Tech Six* engine that puts out 173 horsepower and 220 foot-pounds of torque. That makes Comanche by far the most powerful truck of its kind.

A WIDE RANGE OF VEHICLES: Comanche gives you the choice of two-wheel drive or shift-on-the-fly four-wheel drive. And you can choose between the new shortbed model or longbed with the largest optional 4-wheel drive payload capacity of any truck in its class.



OTHER OPTIONS: Comanche already has a lot going for it. And there's a long list of available equipment that includes a responsive new 4-speed automatic transmission with overdrive.

Check out the new SporTruck and all the other Comanche pickups. It's the kind of truck just about anybody can afford. But it's also the kind of truck only Jeep can build.

*$6,495. Manufacturer's suggested retail price. Title, taxes and destination charges, and options are extra. Price may change without notice. Safety belts save lives.

Jeep Comanche
Available in 2WD and 4WD

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**Take it from Dave Lennox.** You can count on big savings with the Pulse gas furnace.

Most ten-year-old gas furnaces with pilot lights send only 55% to 65% of their heat into your home, losing the rest up the flue. With the Pulse, from 93% to 97% of the heat produced is usable heat. The result? You can cut your fuel use almost in half.

Pulse furnace technology, only from Lennox, is the newest breakthrough in home heating. It uses a unique process that ignites tiny quantities of gas 60-70 times per second. Complete combustion occurs with each "pulse" ignition, delivering almost waste-free heat–and making gas an even better buy.

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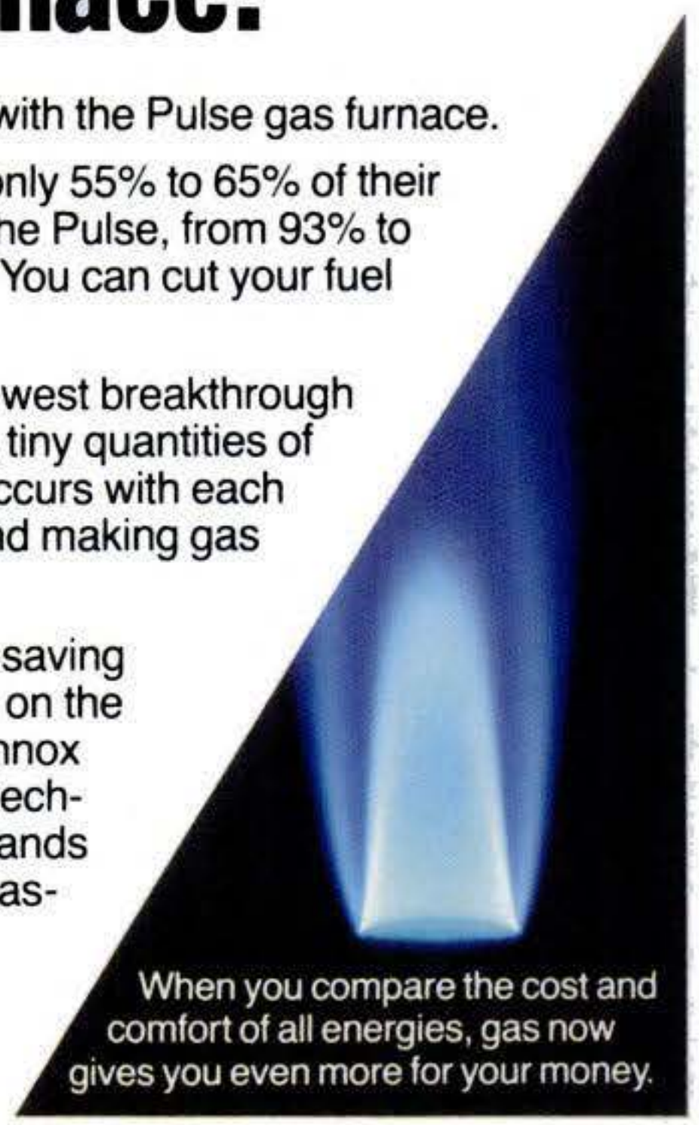

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The WHAT'S NEW magazine
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# What's News

## Propfan test

General Electric Co. has flown the first test version of its unducted propfan [PS, March '85] on a Boeing 727, mounted in place of one of the jet engines at the rear. During the 67-minute flight, everything worked as planned, and GE says the engine could be certified for production by 1990 and in an airplane by 1991 or '92. Airlines are interested because the new-generation propfans will give fuel savings of perhaps 25 percent while flying at jet speeds.

## Maglev in business

The city of Berlin is observing its 750th birthday next year, and to celebrate will put into operation the world's first full-fledged operational magnetic-levitation passenger transport system [PS, Oct. '84]. A one-mile-long first stage is expected to begin service on May 1. The train will be propelled by a linear synchronous motor whose stator lies along the guideway.

## Around-the-world flight

Burt Rutan's *Voyager* [PS, Sept. '84], built to circumnavigate the globe without landing or refueling, has completed a 24-hour warm-up test flight. Copilots Dick Rutan (Burt's brother) and Jeana Yeager said they got about five hours of sleep each during the flight. The 12-day 22,000-mile globe-circling attempt is now scheduled to be made this fall—perhaps by the time you read this.

## Hyundai strikes again

The Korean industrial giant has already scored impressive sales with its under-$5,000 car, which was brought into this country earlier this year. Now the company says it is test-marketing an IBM-compatible computer called the Blue Chip for $699. A black-and-white monitor and second disk drive bring it up to $917. A comparable 512-kilobyte model made by Big Blue goes for $1,945 list.

## New Aerobie

Alan Adler, a Stanford University aerodynamicist, designed the Aerobie, a plastic ring that is first cousin to a frisbee but is more stable, flies better, and goes farther [PS, Sept.]. He offered a $1,000 prize for the first person to throw it more than 1,200 feet, which would be the longest distance anybody has ever thrown anything. There is a winner. He is Scott Zimmerman, who, not surprisingly, is already in the *Guinness Book of World Records* for the previous record toss of 1,125 feet. Zimmerman's $1,000 toss was 1,257 feet at right angles to a 15-mph wind, and lasted 28 seconds. Adler immediately established another $1,000 prize—this one for the first Aerobie toss of more than 1,320 feet—a quarter mile. He can afford it: He has sold more than a million Aerobies at $8.95 each.

## Superconducting generators

The Russians have begun testing a 300-watt superconducting generator —the world's biggest. A generator using superconducting windings has no electrical resistance, so it can be far smaller than a conventional unit and doesn't waste part of its power generating heat. Such units have been under development in the United States and elsewhere [PS, Oct. '74]. But a few years ago, most researchers in the U. S. and Europe gave up the effort because of a slowing in the growth of electrical use.

The Soviet machine has windings of fine threads of titanium-niobium alloy, and is suspended in liquid helium at −565 degrees F. Soviet engineers are also designing a 1,200-megawatt unit, and say they will build a 5,000-megawatt unit early in the next century.

## Chunnel hassle

The British and French are taking turns walking out in a huff from meetings over the Chunnel these days [PS, May]. The point of conflict: Whose high-speed train will go through the under-the-channel tunnel. The French want that honor to go to the 186-mph TGV—*train a grande vitesse* [PS, May '81]. The British, on the other hand, want to use the 140-mph train scheduled for the London-to-Edinburgh run.

## Hot, dry rocks

Researchers in New Mexico have taken a step that may bring geothermal energy a step closer to practicality. The biggest bar to geothermal's widespread use is the fact that deposits of naturally occurring ground water in areas of naturally heated rocks are rare. But hot-rock deposits underly almost all continental masses, and some are fairly near the surface.

The Los Alamos researchers drilled into the hot rock, then pumped extremely high-pressure water into a deposit of rock 13,000 feet beneath New Mexico's Jemez mountains. This technique is called hydrofracturing, and was developed by the oil industry to extract more oil from certain deposits. Once the rocks were broken, the New Mexico team drilled another hole at some distance from the first but also penetrating the crack zone. Then water pumped down one hole flowed through the hot, cracked rocks, picking up heat before coming back up the other hole.

Using this technique, the experimenters withdrew enough 350-degree water to generate power for a town of 2,000 people. Of course, with oil prices dropping sharply, the economic incentive for developing various forms of alternate energy are not as great as they once were. But the supply of oil is limited. It will be in short supply again. The only disagreement is over just when that will be.

C. A. Fillmore
*Editor-in-Chief*


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# HALLEY—

Finally, after 2,200 years of sightings, speculation, and hoopla, astronomers poring over the mounds of data sent back by a bevy of spacecraft are able to state what Halley's comet is really like. Surprising conclusions of a recent symposium: The tumbling comet is jet black and has strange geysers spouting from cracks in its crust.

**By JIM SCHEFTER**
*Painting by Paul Alexander*

Inky black and lumpy, the ancient iceberg tumbled slowly through the void. At its back glowed the sun, inexorably putting on the gravitational brakes. The outermost frontier of our solar system waited far ahead.

Gritty vapor surrounded the old ice block in a luminous cloud, stretching to a long tail now pushed outward by the solar wind. On its sunlit side, a jagged crack ripped across its crusty surface and a geyser of water-rich comet stuff jetted into the dusty glowing sphere that cocooned this potato-shaped relic of time and space. From 33,000 miles and 13 minutes away, a watching camera recorded the event.

Halley's comet, in mid-March, was about to have its fifth visitor from Earth. The European spacecraft *Giotto* was coming. Within 12 minutes, range closed to barely 2,500 miles. The ship was hurtled on through a thickening cloud. Just 14 seconds from its closest approach to the comet's



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# LUJAH!

core, scrubbed by dust and thudded with cometary nuggets, *Giotto* went blind.

Plunging ahead, its antenna skewed away from Earth, the craft flashed 375 miles behind Halley's' mysterious mass, on its sunny side, and disappeared again into the void. Passing velocity: more than 150,000 mph—42 miles in a second.

At the blank screens in *Giotto's* control center at Darmstadt, West Germany, exhausted scientists cheered. But was the spacecraft dead or alive? A minute later, they had their answer. Earth stations were still locked onto *Giotto's* radio carrier signal. The craft was wobbling, but working. Racing away from Halley's comet, its small thrusters slowly damped out the wobble until the signal reaching the control center was loud and clear.

Even better, *Giotto's* on-board recorder held a second-by-second account of its passage. Although the camera lens was forever frosted by abrasive dust and a trio of the ship's sensors were fatally damaged, most of the vital data could be retrieved.

"We can now talk about the origin of comets and of the solar system," said Roger Bonnet, director of scientific programs for the European Space Agency (ESA), at a meeting in Paris two months later. "Comets are the remains of the original cloud [that formed the solar system]." This had long been speculated. Now as leading scientists study data sent back to Earth by an armada of spacecraft, they are finding the proof of this origin embedded in the composition of dust from Halley's. The legendary comet is at last giving up its secrets.

## Exciting discoveries

Two Russian craft, *Vega 1* and *Vega 2*, preceded *Giotto* to the comet. *Vega 1* passed about 5,500 miles from Halley's on March 6. *Vega 2* viewed it from a slightly different trajectory, about 5,000 miles away three days later. In addition to returning a wealth of photos and measurements, both served as pathfinders for *Giotto's* near-collision course with the comet. At about the same time, two Japanese spacecraft, *Sakigake* and *Suisei*, passed the comet at distances of 4.3 million and 94,000 miles, respectively. Neither of the craft had a camera, but they concentrated on collecting information on how the comet interacts with the solar wind and the general space environment.

The collective findings set the scientific community abuzz:

- Halley's comet is much larger and blacker than expected. "Its size is about nine miles by six miles, and the color is black velvet," said Dr. Asoka Mendis, physicist from the University of California at San Diego. Mendis was a co-investigator on *Giotto's* electron spectrometer and its heavy-ion analyzer.
- The comet tumbles slowly, rotating every 52 hours.
- It is indeed an icy snowball, as astronomer Fred Whipple first proposed for comets in 1950. But its surface is crusted with nonvolatile organic-rich materials. On the sunlit side, the crust sometimes cracks open, releasing massive jets of water vapor and dust that create the coma and eventually the tail.
- At its most active, Halley's spewed out more than 16 tons of material per second and lost a total of about 165 million tons of mass during its 1985–'86 passage around the sun. At that rate, it will survive another 253,308 years, or 3,300 more returns, said Dr. Tony McDonald of the University of Kent at Canterbury, England.
- Water vapor accounts for 80 percent of the comet's gas cloud. But organic compounds, including benzene, were found, as were heavier molecules of metallic elements.
- The comet's coma contains significantly fewer dust particles than expected. Even so, *Giotto* recorded 12,000 impacts before its closest approach, including 150 of microgram size and 10 big enough to rock the spacecraft. It was the last of those that put the ship into a wobble.

Perhaps the most important discovery about Halley's was its physical appearance. It's an elongated mass, almost potato-shaped, with a knobby protrusion at one end. Its velvet-black surface, lumpy and cracked, is a hydrocarbon-rich crust of unknown thickness; estimates range from ¼ inch to several yards. The crust itself prevents the underlying ice from evaporating or sublimating, even though *Giotto* and the *Vegas* measured its surface temperature at about 86 degrees F.

The comet's unusual size and potato shape first became apparent in the 1,500 television images transmitted to Earth by *Vega 1* and *Vega 2*. Astronomers had expected

*Continued*



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Halley's to be more spherical, with a diameter of about four miles. As *Vega 1* trained its two cameras on their target, scientists waiting at the Space Research Institute in Moscow saw not one, but two bright objects on their screens, surrounded by a vague, darker area.

## Fooling the experts

Their first reaction was that Halley's comet had either a split nucleus or, more radically, a central mass with its own satellite. "Some of the scientists got excited and even calculated a period for the 'satellite,' " Mendis said later. But gradually the truth became clear. As the *Vegas* approached Halley's from 5,000 or more miles away, they were able to photograph the comet from many angles. The earliest scenes, Russian scientists reported later, showed the comet with its larger end facing the spacecraft. The bright objects, it turned out, were large jets of gas and dust erupting from Halley's. The bright geysers all but obscured the solid mass. But as the *Vegas* moved around the comet, continuing to photograph it through 1,200- and 150-mm lenses, its shape became obvious. The dark area was, in fact, the comet.

According to Mendis, these phenomenal spews that so fooled the experts come from fissures and cracks that form naturally in the comet's crust. "Even if you start with a uniform crust, there is a tendency for it to split because of dynamic stresses, gravitational forces, and uneven heating," he said. When that happens, particularly when Halley's is close to the sun, water and dusty vapor trapped beneath the crust spray into space. The force of these cometary geysers, which can extend more than 100 miles outward, can be enough to cause minor changes in the comet's trajectory. But most important, the jets of gas, water, and dust carry the small particles that help form the tail and coma. Larger grains remain behind or fall back to the surface, creating the crust. As time passes, the crust gets thicker and blacker. The comet's nucleus now reflects only two percent of the light reaching it.

"There also is likely to be a healing process for the fissures," Mendis said. "Dust falls back into them, and the dynamic stresses and heating cause them to seal up. There is no reason to believe that the same fissures that were there in 1910 [at the comet's last apparition] are still there today." In fact, the picture drawn by the visitors to Halley's is hardly stagnant. It is one of frozen solitude, punctuated by sudden and violent episodes occurring randomly on its sunward face.

At the same time that the comet's shape was being investigated, the *Vegas* revealed that dust content inside the coma was less than expected. Each spacecraft carried a dust counter and mass analyzer designed by Dr. John Simpson of the University of Chicago's Enrico Fermi Institute. *Vega 1's* counter picked up its first dust impact about 396,000 miles from the comet. *Vega 2* was much closer, 158,000 miles, before it found dust.

In both cases, Simpson reported, the dust farthest from the nucleus had the smallest mass. That contrasted with speculation that heavier dust particles would be propelled farther and faster by the solar wind, and that the lightest dust would be found in the coma's central region. Hit rates on both ships increased to more than 50 per second nearing closest approach.

At one point *Vega 1* encountered a sharp increase in dust, with hits briefly exceeding 4,000 per second before tapering off. Simpson attributed the phenomena to a dust jet spouting from the comet's active side. The spacecraft passed through the jet in seconds; three days later *Vega 2* passed the same way without encountering the plume.

None of the impacts were satellite-killers. Some instruments failed or were degraded, reported chief mission scientist Roald Sagdeev, but not before completing their assignments. The *Vegas* survived in such good shape that the Russians are now considering new missions for them, including retargeting to an asteroid. *Giotto*, too, is quiet now. It is returning to close approach with Earth in 1990, when it also may be given a new assignment.

## Sharing dusty origins

Scientists now expect to spend long months analyzing readings from the *Vegas'* spectrometers, energetic particle analyzers, wave and plasma recorders, and magnetometers. Much of the early analysis agreed precisely with *Giotto's* findings. The Russians relayed dust counts and precise location of the comet's nucleus from Moscow to Darmstadt, where ESA scientists used the *Vegas'* data to confidently aim *Giotto* to penetrate the core of the coma and skim past the rumpled surface of Halley's.

As *Giotto* swept inward, its 10 scientific experiments began to unlock more of the comet's secrets. Instruments recorded a small shock wave in space where the comet's minimal magnetic field met the solar wind and then discovered a magnetic-field cavity tightly surrounding the comet's nucleus. "It's a unique discovery," Dr. Fritz Neubauer of West Germany's University of Cologne said during the Paris meeting in May. "The total field is very low, about one-thousandth of the field in this room." Why the field should disappear entirely near the comet is a new mystery for scientists to unravel.

About 205,000 miles from Halley's, *Giotto's* ion mass spectrometer picked up the first signs of water and carbon dioxide in the coma. The water ions appeared suddenly, reported Hans Balsiger of the University of Switzerland. At about 40,000 miles, another spectrometer found the first sulfur ions. The findings strengthened speculation that organic materials would be found in comets.

Dust impacts increased dramatically in the final minutes before closest approach. "Most of the particles are emitted from the warm side of the comet," said the University of Kent's McDonald. That was the side *Giotto* approached. "Before the encounter, the dust was dominated by larger particles. After the encounter, we saw more smaller particles associated with the jets." McDonald attributed the phenomena to the rotation of Halley's, which propelled particles quickly along *Giotto's* outbound path. The dust has a lingering effect for earthlings. "We see the particles as shooting stars in the sky after they've made many orbits," he said. "The larger particles make up the meteor strings visible from Earth."

According to Dr. J. Kissel of the Max Planck Institute, the *Vegas* and *Giotto* used similar instruments to measure dust composition of Halley's. "We found three classes of particles," he said. "First, carbon, oxygen, hydrogen, and nitrogen; second, magnesium, silicate, and iodide; and third, metallic elements like sodium, magnesium, aluminum, manganese, and nickel." These preliminary analyses, Kissel said, seem to verify models that predicted the presence of organic compounds in comets. Since the dust also contains many of the primordial components that condensed to create our solar system, Halley's comet is almost certainly a leftover scrap that wasn't collected by a passing planet or moon. But the theory that comet material would closely match the composition of common carbonaceous meteorites now must be revised: Halley's comet, among other surprises, has a richer variety of metals.

Now fading and distant, visible only with the best earthbound instruments, Halley's continues its trek outward. It will not return until 2061. Its legacy is a treasure trove of data that will be studied and discussed by scientists long after it fades beyond the best telescope's reach. PS



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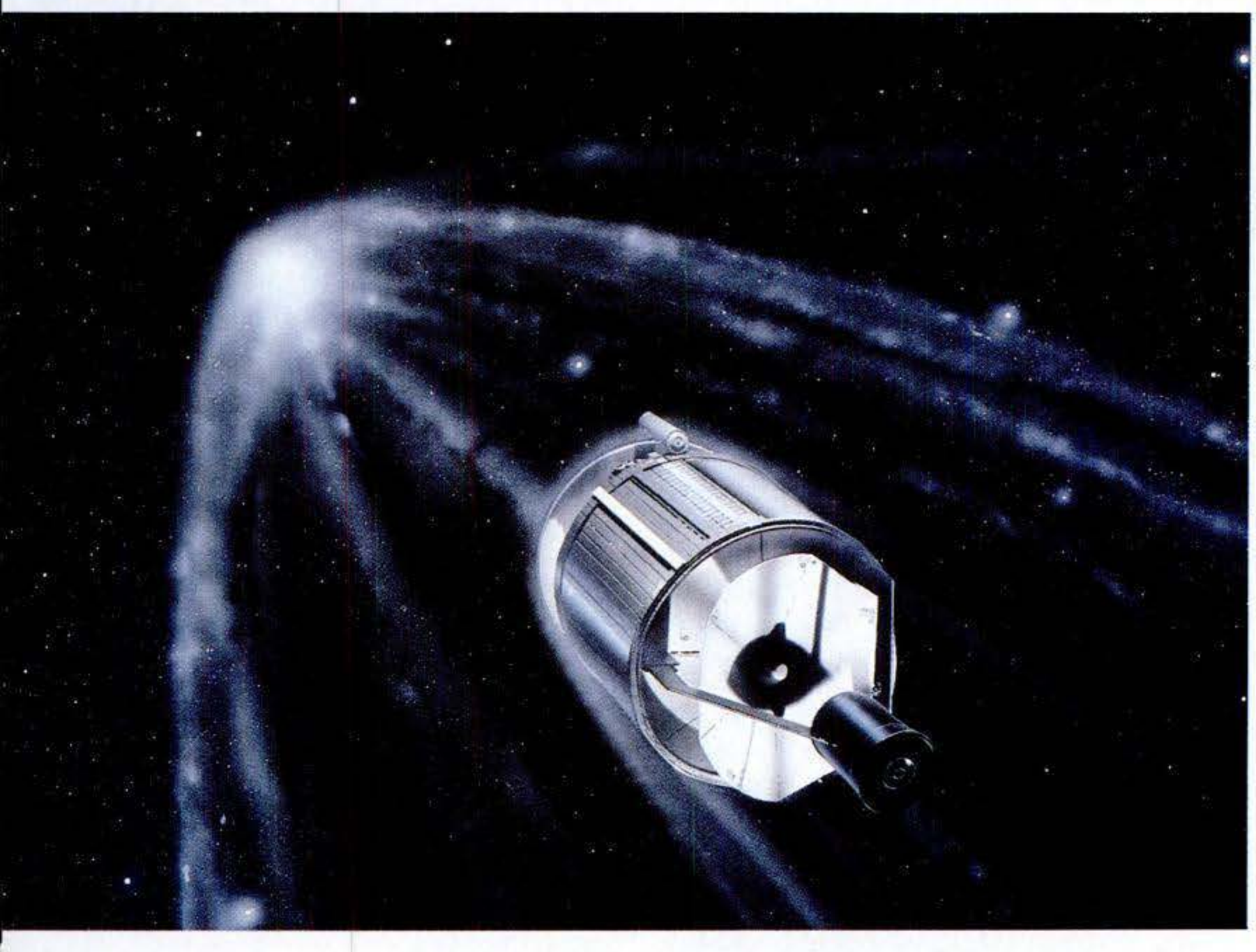

PAINTING BY BRIAN SULLIVAN

**The potato-shape nucleus of Halley's is obscured by two bright spots, which are enormous jets of dusty vapor shooting out from the side of the comet facing the sun (top photo). At first, scientists thought the bright spots meant that Halley's had a split nucleus or even its own satellite. But when the European Space Agency's *Giotto* passed only 375 miles from the comet's icy nucleus—the closest approach ever—the jets became obvious (painting at left). Pelted by cometary debris as *Giotto* hurtled through space at an average speed of 150,000 mph, the spacecraft's camera lenses were mortally wounded by abrasive dust.**



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# Five-valve fire breather

Yamaha engineers devised a five-valve cylinder head for their most sophisticated sport bike. The FZ750 uses 20 little valves to deliver scorching performance.

**By STUART F. BROWN**
*Photos by Tom Wilkinson*

The question that intrigued designers at Yamaha Motor Co.'s advanced engine-technology research section in Japan was this: Since four-valve cylinder heads are capable of generating much more horsepower than traditional two-valve heads, mightn't a motorcycle engine with more than four valves be an even hotter performer?

Several years of development work later, the engineers had built and tested high-performance engines with five-, six-, and—incredibly—seven-valve cylinder heads. And they showed that there's a distinct payoff in increasing complexity—up to a point.

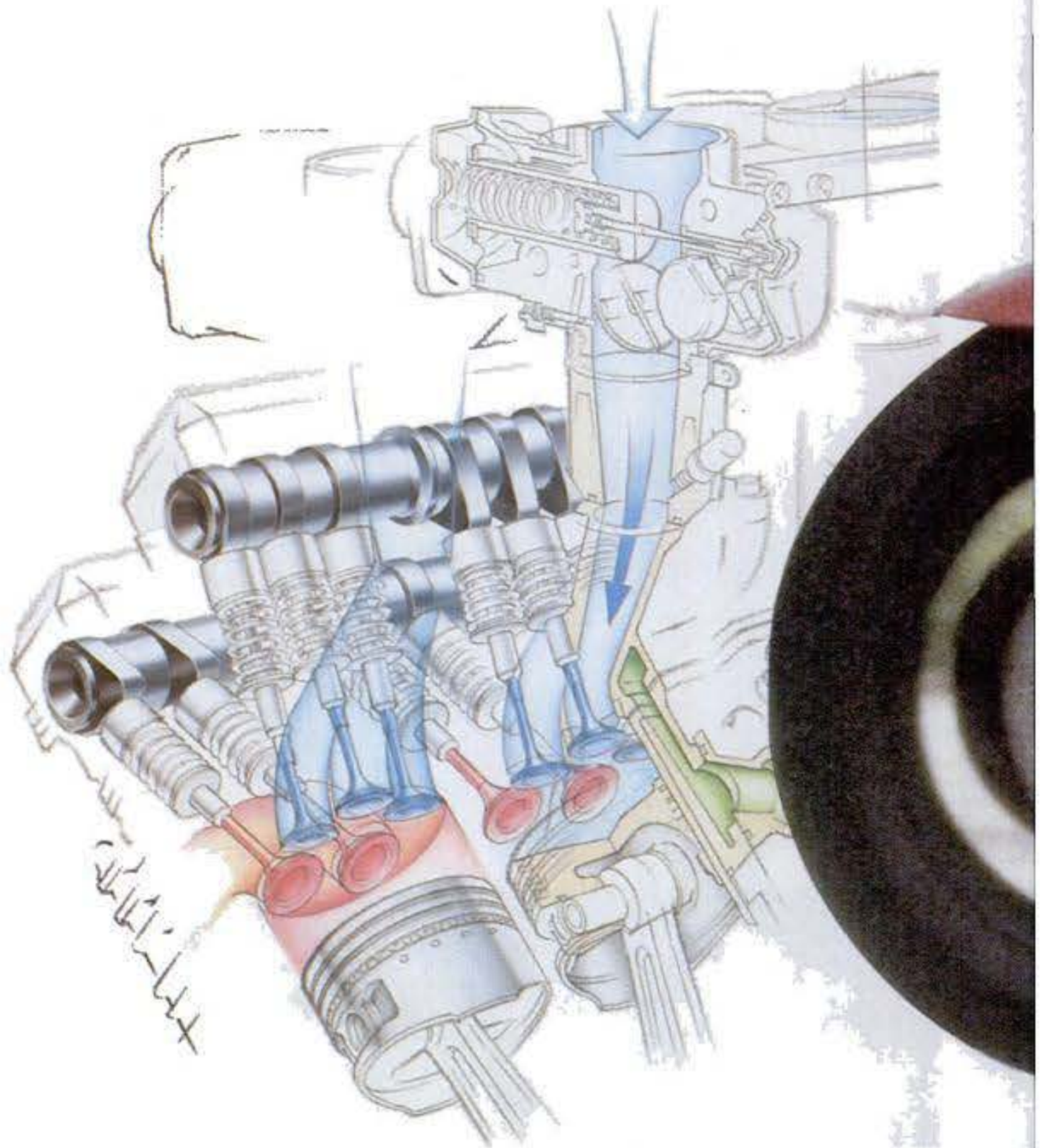
The result of the multi-valve development program is the engine of the FZ750, a street motorcycle that delivers the acceleration, braking, and cornering of a full-blown road racer. And it is equally content to idle along in stop-and-go traffic at 1,000 rpm in bottom gear.

In fact, the FZ's throttle reminds me of the transformer that came with my old American Flyer electric train set: turn the control some more, and out flow more power and acceleration, smoothly and without surprises. In the fleeting moments it takes the tachometer needle to sweep up to its 11,000-rpm red line, claimed output at the crankshaft has reached an attention-grabbing 100 horsepower.

According to Yamaha engineering division manager Stephen Doi, the switch from four valves per cylinder to five increases a 750-cc engine's horsepower and torque by about 10 percent, as well as broadening the torque curve. The gains are due to improved volumetric efficiency—a measure of how completely the cylinders fill with the fuel-air mixture on each intake stroke. Even though they are relatively small in diameter, the FZ's three intake valves have more total circumference than would a pair of larger intake valves. The greater intake area around the triple valve heads increases the amount of fuel mixture that can enter the engine, raising power output.

When prototype cylinder heads were built using more than five valves, however, total valve-opening area decreased, and so did the performance gains. Yamaha actually built and tested a 28-valve V4 engine that used two spark plugs per cylinder and revved up to 20,000 rpm. This seven-valve design was eventually discarded because of high cost and detonation-provoking hot spots that tended to form between the three closely spaced exhaust valves.

The five-valve configuration eventually chosen for the FZ750's liquid-cooled four-cylinder engine permits a highly efficient lens-shaped combustion-chamber design. Using a central spark-plug location and recessed piston crowns, this layout ensures quick and uniform flame propagation, allowing an 11.2:1 compression ratio without detonation. Another benefit of small valves is reduced mass; they can run at higher rpm without floating, or failing to fully close, and can use lighter springs that quicken response time.



**The FZ750 engine inhales fuel mixture (blue) through triple intake valves and expels burned gases (red) through paired exhaust valves. Four downdraft carburetors mix the fuel.**

All of this mechanical sophistication is nestled in a rigid box-section steel frame incorporating a link-type mono-shock rear suspension with adjustable damping and spring rate. Dual front and single rear disc brakes provide low-effort, controllable stopping power. During the time I had the $4,600 FZ for testing, it didn't spend much time in the garage. The impulse to go out and find a curvy road —this bike's natural habitat—was irresistible.

Yamaha's idea of using many-valved cylinder heads to make more power has not gone unnoticed by the auto industry; in Italy, Maserati recently announced that it will produce a six-valve version of its Biturbo V6 engine. PS



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The 750-cc engine slants 45° forward to equalize front-rear weight distribution. The bike is agile and stable at all speeds.

## Simply modern

For decades, the recipe for a back-road-burning motorcycle read like this: a torquey four-cycle engine with one large cylinder slung in a narrow, sure-handling frame. These British "big singles" bore such logos as Norton, BSA, or Matchless. Now, in an era where dazzling complexity is the vogue, Yamaha has revived this straightforward formula and brought it up to date. With the notable omission of an electric starter, the SRX-6 combines all the features that make modern better in a deft-handling 375-pound package. Well-chosen suspension components, a flex-free frame, and a trio of excellent ventilated disc brakes make the $2,600 SRX one of the nicest ways I know to negotiate a twisty country lane. Two complaints: First gear's a bit too high for stop-and-go riding, and kick starting gets boring in a hurry.—S. F. B.

SRX-6's 600-cc engine sports four valves, twin carburetors that optimize fuel delivery across the engine-speed range, breakerless electronic ignition, and a vibration-damping counterbalancer. Claimed output: 41 hp.


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# TRACTION!

## *Tailored 4WD power for all-out performance*

**By TOM WILKINSON**
*Drawings by Ed Figueroa*

It was a common enough mishap. Rounding an icy hairpin high in the Colorado Rockies in a Volkswagen Vanagon, I came face to face with an enormous four-wheel-drive truck. Staring straight into the steel beams of its snowplow mount, I panicked briefly and tapped the brake. By the time I took my foot off the pedal, it was too late. The Vanagon was skating slowly across glare ice, heading straight for a snow-filled ditch. Finally, with a gentle crunch, the right side of the van settled into the deep snow, resting at a 45-degree angle.

No doubt surprised to find anything larger than a mule deer on the deserted mountain road, the truck driver stopped to help. But this was no ordinary Vanagon. As the trucker watched, I flipped a switch to lock the rear differential of its four-wheel-drive system, shifted the transmission into low, and drove right out of the ditch and back onto the road.

The viscous-coupling four-wheel drive that pulled me from the snowy ditch is one of the latest developments in the race to improve traction of passenger cars. Though simple part-time four-wheel drive continues to grow in popularity, advances in electronics and silicon chemistry are leading to sophisticated new four-wheel drives that engage automatically. And in the wings is electronic traction control for two-wheel-drive vehicles.

Part-time versus full-time. Mechanical versus electronic versus viscous. The competing claims are confusing. Why so many choices? And which is best for keeping you moving on a slippery road?

### Simplest system

The simplest four-wheel drive locks front and rear axles together so that all four wheels get power in mud, sand, or snow. And these slippery surfaces prevent wind-up, a major problem with such systems as they go around curves. Wind-up occurs because front and rear tires rotate at different speeds as they follow slightly different radii through a corner. Though simple four-wheel drive forces the tires to turn together, it's no problem—poor traction just lets each tire slip a bit.

On a dry road, though, it's another story. Forcing the axles to rotate at the same speed will either cause the tires to break traction, or it will snap something in the drive line. The so-



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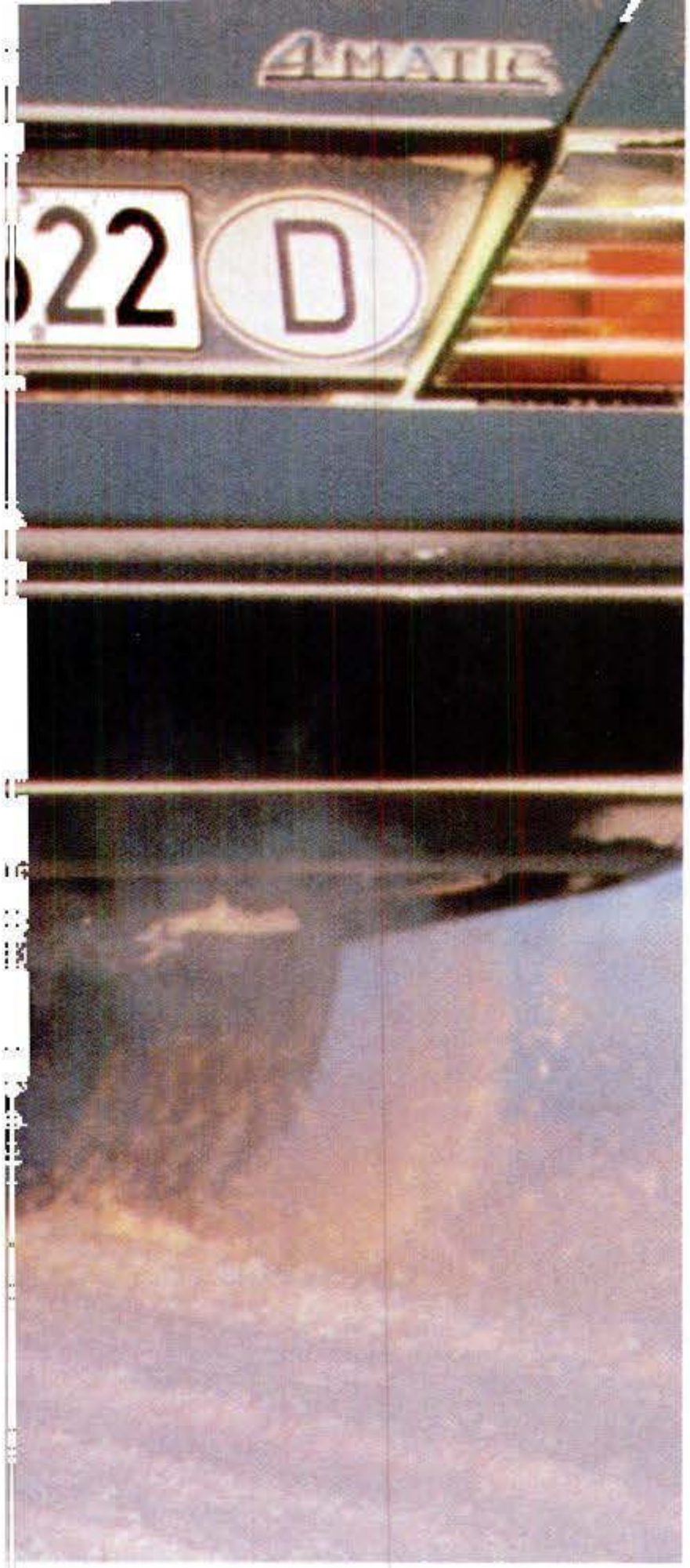


lution: part-time four-wheel drive that you engage when you need it, disengage when you don't.

Such part-time systems are popular for compact station wagons, trucks, and utility vehicles. But now many designers want to go beyond these manually engaged part-time systems.

Some engineers say drivers don't understand exactly when a part-time system should be engaged. Others think luxury-car buyers might object to four-wheel drive they have to engage by yanking a lever sticking out of the floor. As Martin Stengel, an engineer at Daimler-Benz, put it, "It isn't important that the driver knows what is working. It's just important that he knows *something* is working."

Audi, whose Quattro system kicked off the current four-wheel-drive craze in Europe, uses a center differential to permit full-time engagement. As long as each tire has traction, the system distributes the engine's power evenly to all four wheels, giving Quattro-equipped cars almost catlike traction on dry and slippery roads.

The problem is, the car still needs occasional guidance from the driver, as I discovered on a muddy farm road deep in the Colorado wilderness. I was driving a VW Quantum station wagon fitted with the Quattro system. It was all too easy to get one wheel in a mud hole, and when that happened, the differentials simply routed all available power to the one spinning tire, digging it in deeper. I could manually lock the center and rear differentials via knobs on the dash, and the car would churn right out. But just as with with a part-time system, I had to use both my head and hands.

Also, like part-time four-wheel drive, the Quattro system, with differentials locked, forces the wheels to rotate at the same speed. This causes wind-up if you pull onto a dry road with the locks still on. Also, a locked Quattro system is incompatible with anti-lock brakes [PS, Nov. '85 and Nov. '84].

With an anti-lock braking system (ABS), a sensor at each wheel tells a computer if any wheel starts to slow too rapidly during braking—a sign that the wheel is about to lock and put the car into a skid. The computer then reduces hydraulic pressure to the brake on that wheel. This lets each wheel keep rolling yet still apply the maximum braking possible for the conditions.

For anti-lock brakes to work properly, each wheel must be able to rotate independently, so locked differentials are incompatible. Audi solves this problem—after a fashion—with a circuit that deactivates the anti-lock system whenever the driver locks the center differential.

## Silicon solutions

The challenge, then, is to find four-wheel drive that will slog through the deepest snow or stickiest mud without any help from the driver, and is always compatible with anti-lock brakes. As its solution, VW recently intro-

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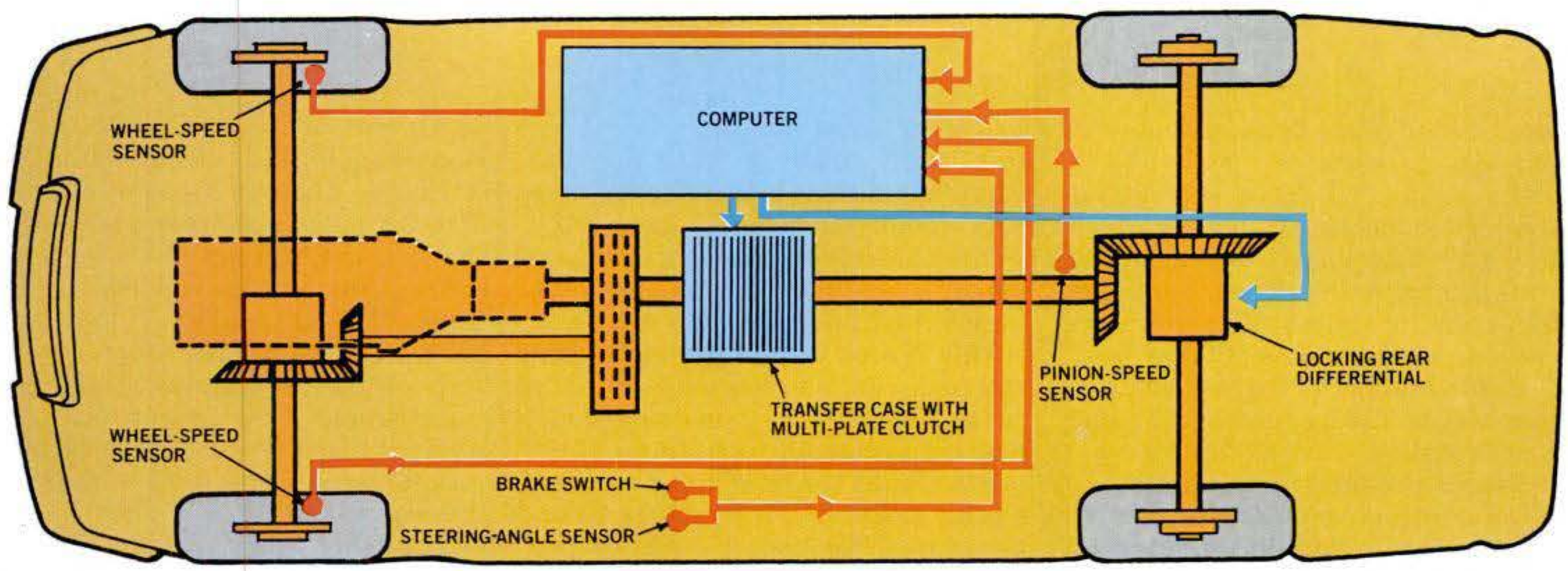


**Mercedes 4MATIC, perhaps the ultimate in four-wheel drive, feeds information on wheelspin, steering angle, and brake application into a computer. If one of the rear wheels starts to spin, the computer engages the transfer case, sending power to the front axle. If more traction is needed, a multi-plate clutch progressively locks the center differential. If wheelspin is still a problem, a second hydraulically actuated clutch locks the rear differential. Applying the brakes causes 4MATIC to disengage, so the anti-lock brakes can function normally. Though 4MATIC is effective and unobtrusive, both the hardware and computer program are exceptionally complex—and expensive.**



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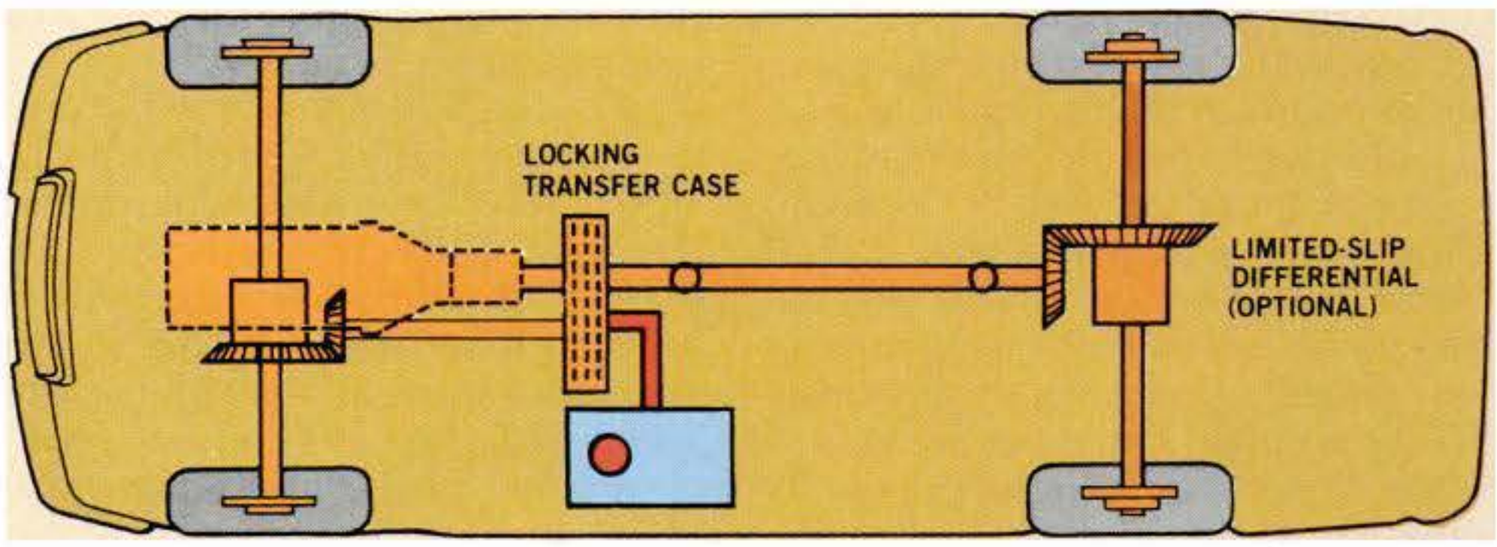
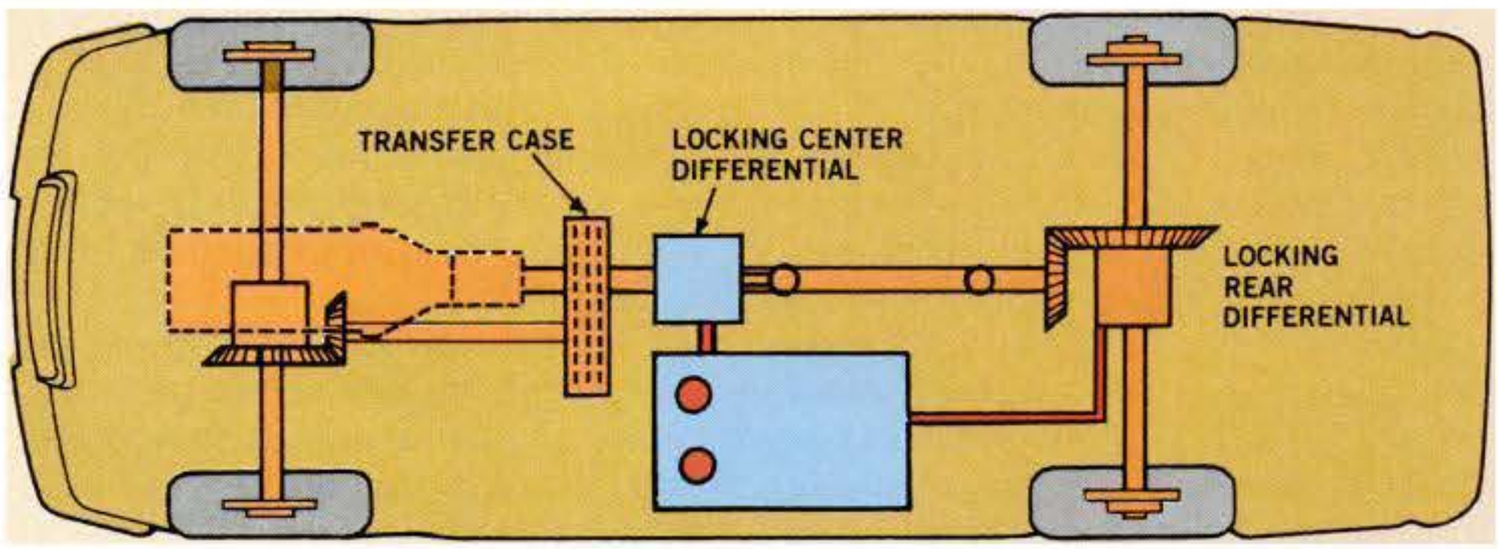
## Part-time four-wheel drive



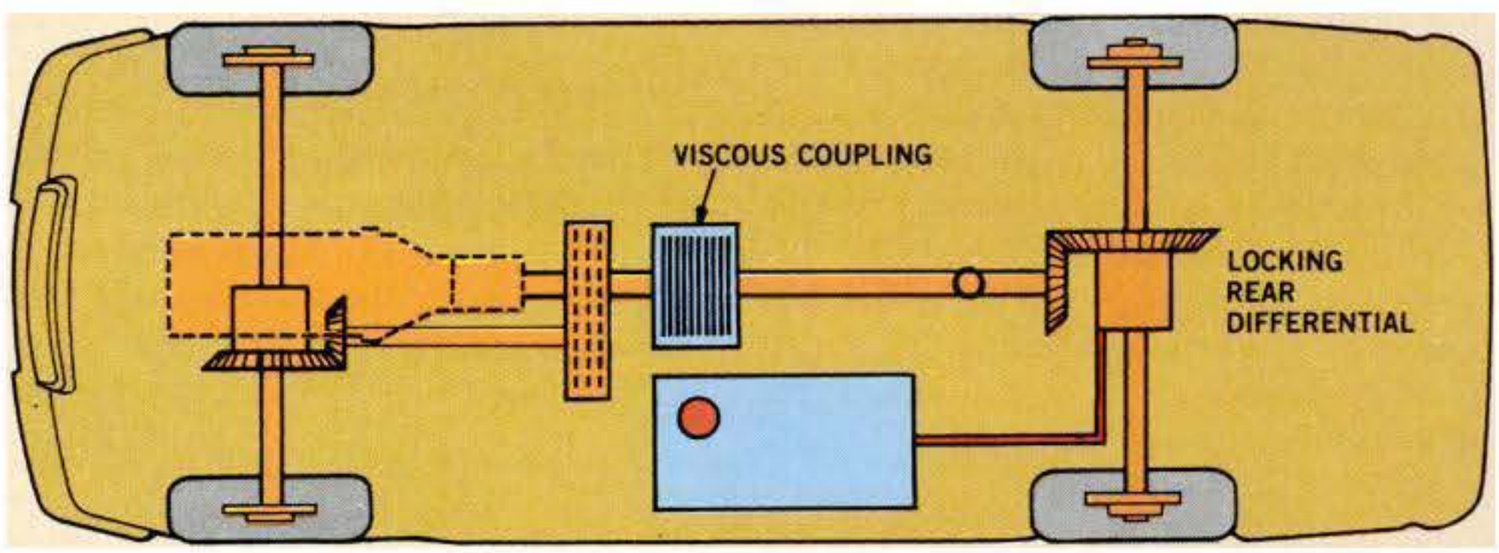

**Manually engaged four-wheel drive is available on utility vehicles, small station wagons, and the 1987 Ford Tempo and Topaz. The driver switches on the system for slippery conditions, then turns it off when it's no longer needed. Part-time systems are simple, rugged, and effective. But they can cause tire chattering or drive-line damage if left engaged when driving on dry roads. And four-wheel drive and anti-lock brakes can't be used at the same time.**

## Differentials for full-time traction




**The full-time four-wheel drive developed by Audi and used on its Quattros and VW's Quantum uses conventional differentials front, center, and rear. Torque is split evenly between axles. By distributing driving traction to all four wheels, the system improves handling on both dry and wet pavement. But the center and rear differentials must be manually locked (and anti-lock brakes disengaged) in snow, mud, or other extreme conditions.**

## Viscous four-wheel drive




**4WD with viscous couplings is being developed by a number of auto makers. Alternating plates connected to each half of the drive train ride in thick silicone fluid; if one shaft starts to spin faster than the other, the coupling transmits more torque to the slower shaft. By modifying the chemistry of the fluid, VW has developed a coupling that can almost instantly lock front and rear axles together. A manually locked rear differential is optional.**

duced a four-wheel-drive system with a viscous coupling.

The Vanagon I drove out of that snowy ditch had this system, in which the center differential is replaced with a viscous coupling. Such couplings aren't new, of course. They were developed decades ago and have been used in a number of four-wheel-drive systems. But VW engineers have found a new twist.

Viscous couplings incorporate two sets of interleaved plates—one set attached to an input shaft, the second attached to the output. The coupling is filled with thick silicone fluid ["Automotive Newsfront," PS, Aug.].

Most viscous couplings transmit driving force in proportion to the speed difference between the plates. But now, by tweaking the chemistry of the fluid, VW has made a coupling that locks up almost instantly. When shear forces between the plates raise the temperature of the fluid to about 100 degrees C, the silicone thickens almost instantly, effectively locking the coupling. "The temperature increase takes only about 0.2 second," says Rudy Weissner, senior manager for engineering at VW. "This means the force transmitted increases very rapidly."

This center coupling allows front and rear wheels to roll independently on dry pavement, as long as speed differences are small. But if one wheel starts to spin, the fluid in the coupling quickly locks the axles together. Weissner admits, "We know the fluid works. But we don't know all the details of why it works. So we do a lot of research."

Indeed, the viscous-equipped Vanagon did work well, climbing icy hills like a mountain goat. But there still appear to be minor problems. First, when the coupling locks, it ties front and rear axles together so tightly that the system is incompatible with ABS. This isn't a problem for the Vanagon, which isn't offered with ABS. But a viscous-equipped Golf sold with ABS in Europe requires a one-way clutch that disconnects the rear-wheel drive shaft during braking.

Also, the current Vanagon uses a standard differential in the rear, with a manual lock offered as an option. This means the viscous system engages automatically only up to a point, a point I reached when I dropped both wheels on one side of the Vanagon into the snow-filled ditch. I then had to manually lock the rear differential to keep going. Weissner said VW wants to make the system completely hands-off, so a viscous limited-slip rear differential is being considered.

While VW and others pursue the chemical intricacies of silicone fluid, Daimler-Benz is working with another kind of silicon—semiconductors. Its 4MATIC computerized all-wheel drive may be the most complex—and expensive—yet devised. But 4MATIC



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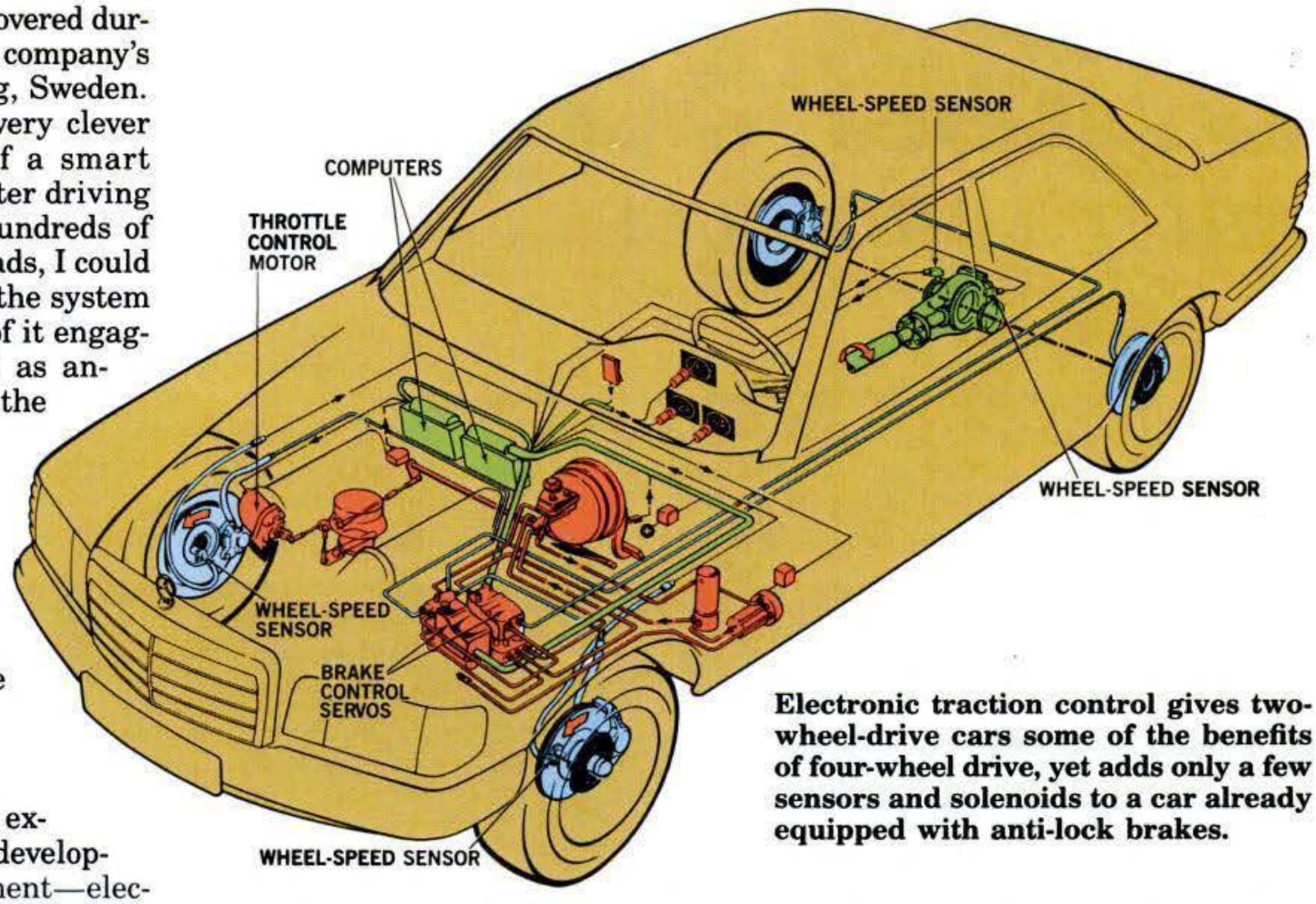
does work as claimed, I discovered during a visit last year to the company's winter test site in Arjeplog, Sweden.

Think of 4MATIC as a very clever part-time system, sort of a smart Subaru, if you will. And after driving a 4MATIC-equipped car hundreds of miles over snow-covered roads, I could find no fault with the way the system works. I was never aware of it engaging and disengaging. And as another journalist discovered, the only way to get the car stuck was to bury it up to its windowsills in a snow bank. The only problems with 4MATIC appear to be its complexity and cost—word is it may add $5,000 to the sticker price.




**Electronic traction control gives two-wheel-drive cars some of the benefits of four-wheel drive, yet adds only a few sensors and solenoids to a car already equipped with anti-lock brakes.**

## Tomorrow's traction

Engineers I talked with expect at least two further developments in traction enhancement—electronic traction control for two-wheel drive, and four-wheel drive using something engineers call Torsen differentials.

First, the two-wheel-drive system. Called ASR (acceleration skid control), it uses anti-lock wheel-speed sensors to detect any loss of traction. If one wheel starts to spin, ASR pulses the brake to that wheel, transferring torque through the differential to the wheel that still has traction. If both wheels spin, the computer backs off the throttle until traction is restored.

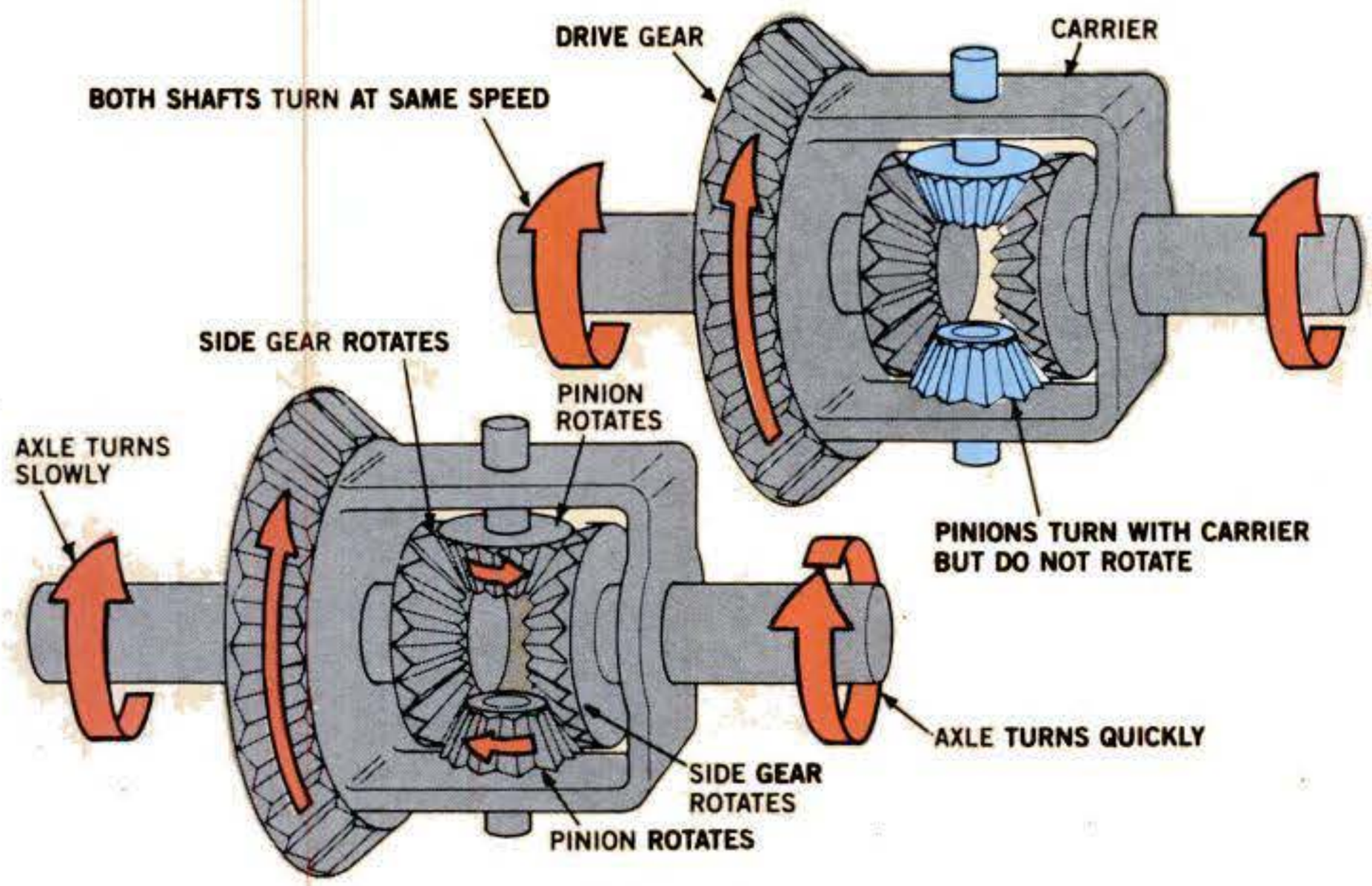
Car makers are enthusiastic about traction control because it provides better grip than a standard differential, yet adds little cost to a car already equipped with anti-lock brakes. But my test drive of a Mercedes-Benz 300E with ASR indicated that the system needs refinement.

In contrast to 4MATIC, the prototype ASR was hardly quiet or competent. When the brakes started to pulse, they sounded like some Norse demon trapped under the car. And because ASR would slow the car until there was no wheelspin, the test car would climb a snowy mountain road far faster with the system switched off. Yet when starting out on the hill, ASR would let the tires slip enough to polish the snow, making it necessary to back up a few feet and try again. And ASR couldn't pull a car out of a ditch or snow bank, something even the crudest four-wheel drive can do.

Finally, look for a second-generation Audi-VW system with Torsen differentials, which use a complex system of gears to provide smooth, automatic locking. "Consider integrating Torsen differentials into the Quattro system," says Weissner. "Then you'd get a completely variable distribution of driving forces."

By a method too complex to explain here (see "Gleason's Impossible Differential," PS, Feb. '84), Torsen differentials would allow each wheel to rotate at a different speed, yet would prevent loss of driving force if one tire started to spin. So they could make possible permanent, hands-off four-wheel drive that's compatible with anti-lock brakes.

But whatever system wins the traction-technology race, the outcome is likely to be good news. After all, without four-wheel drive I might never have gotten that Vanagon out of the ditch. Of course, without it, I might never have gone up that mountain in the first place. But then that's a quandary no amount of clever engineering will ever be able to resolve. PS




## Differentials for smooth power flow

**A typical differential allows two wheels (or two drive shafts in four-wheel drive) to work together smoothly. Normally, the four bevel gears within the carrier are stationary, and both shafts turn at the same speed as the main gear. But because motion can be freely transferred through the differential gears, the shafts can turn at different speeds when necessary.**

**Problems arise if one wheel (or axle) loses traction. The differential then sends all the driving motion to the spinning shaft, and the car goes nowhere. Consequently, four-wheel-drive vehicles need some form of limited-slip or locking differential in the center; designers often add a similar differential at the rear. A locking differential at the front would adversely affect steering.—T. W.**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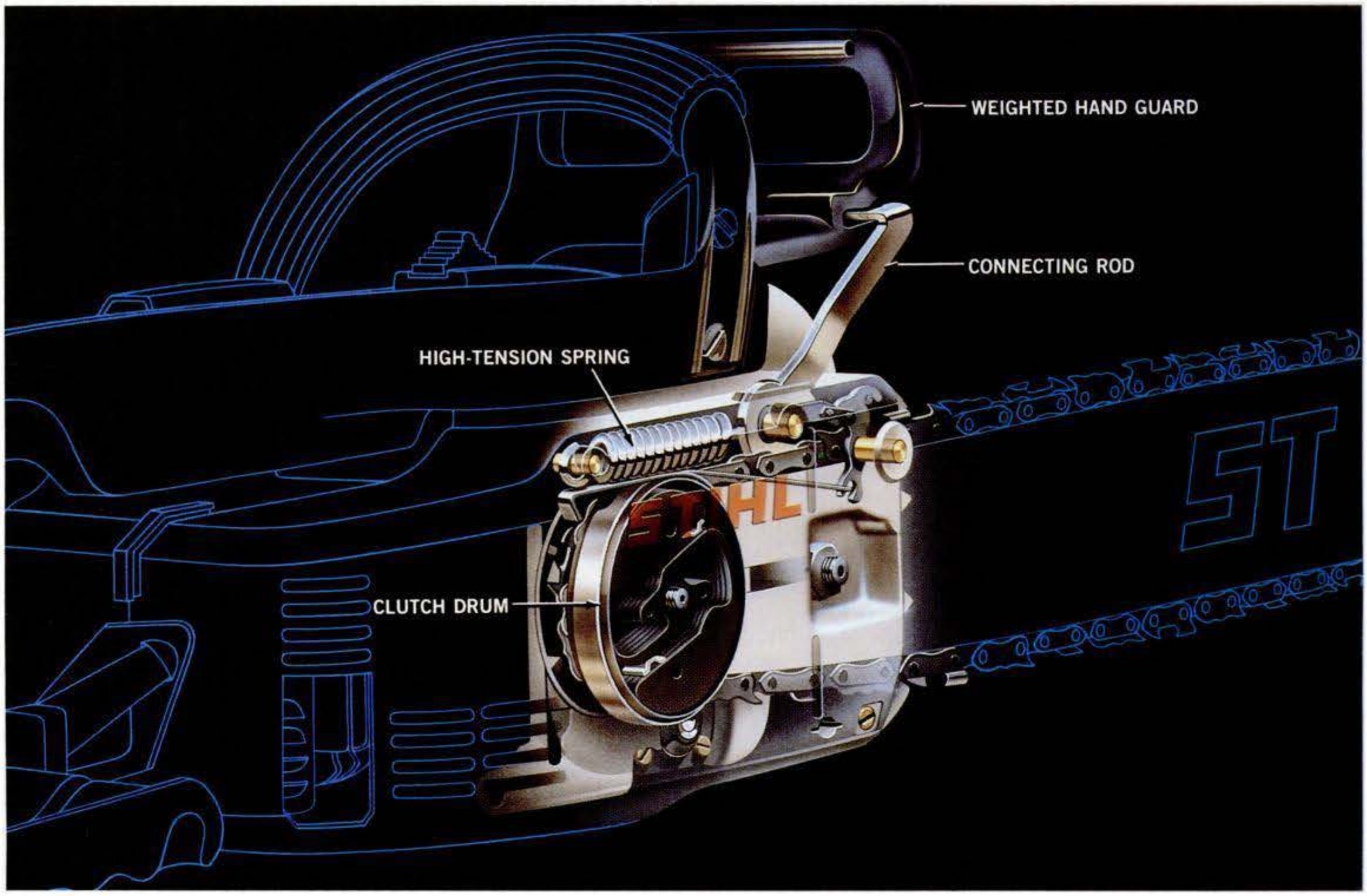
# Chain saws —safer than ever...

By DAWN STOVER

Each year, approximately 63,000 Americans go to emergency rooms to be treated for chain-saw injuries. A few of them die. According to the U.S. Consumer Product Safety Commission's (CPSC) Directorate for Epidemiology, most of the accidents are caused by problems for which technology has no solution: The operator touches a chain while he's changing position, he loses his balance, or he trips over the saw. But about one-fifth of the accidents and a dozen of the deaths are attributed to a phenomenon called rotational kickback: The upper quadrant of the bar tip contacts an object during operation, transferring all of the chain's energy to the saw, which then revolves back




A steel band grips the chain-brake clutch drum when a jolt causes the weighted hand guard to release the spring.

# ...but you're still the key

By AL LEES

Whatever protective devices manufacturers build into their saws to comply with the American National Standards Institute Standard, there's no way to make a chain saw a truly safe tool for the casual user. The very nature of the beast is snarly. To do its job, a chain saw must present a long, naked bar with a chain of sharp teeth racing around its tip; and because the bar must bury itself in the wood, the chain can't be sheathed with any type of guard. Even a tip guard, such as Homelite promotes, must be removed for certain types of cuts.

Built-in safety can do a lot to reduce kickback, but most chain-saw injuries involve careless use or abuse of the tool.

I've been interviewing safety engineers and experts at major chain-saw manufacturers, and although they differ widely in their assessments of how to make the tool itself safer, they all

[Continued on page 102]

SHINDAIWA

Safe stance puts body to one side of cut line. If bar kicks back, it won't strike operator. Note gloves and chaps.



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toward the user. Rotational kickback can also be caused by human error, but unlike the other hazards, it can be prevented by changes in the design of the chain saw.

Chain-saw companies have been under pressure to add anti-kickback safety features ever since the chain saw became a popular consumer tool for cutting firewood in the early 1970s. Today "the respect level is down," says Dick Marsh, U.S. manager for Alpina, an Italian chain-saw manufacturer. "Some of the small saws look like toys."

In March, the chain-saw industry, in cooperation with the CPSC, adopted the voluntary American National Standards Institute Standard for anti-kickback equipment. It applies to the smaller gasoline-powered chain saws used by nonprofessionals, and it mandates that a saw have a hand guard and at least two safety features that keep the saw from rotating backward by more than 45 degrees. The current safety features include reduced-kickback chains, low-kickback guide bars, bar-tip guards, and chain brakes.

How do these features reduce kickback? And how effective are they? In speaking with experts in the industry, I found that although the features reduce kickback injuries to some extent, many manufacturers disagree on which are the best features to ensure safety. Some of the devices have created new maintenance and performance problems.

## Coping with kickback

All of the 15 or so chain-saw manufacturers use reduced-kickback chains, introduced in the 1970s [PS, Nov. '80, Jan. '84]. The five chain makers that supply the industry use different designs (see photo, next page), but they all have the same goal: to prevent the chain from binding in a log. Everyone in the industry seems to agree that safety chains are not as "aggressive" as their predecessors: They tend to reduce cutting speed by 10 to 20 percent because they take smaller "bites."

After the anti-kickback chain, the most widely used safety feature is the chain brake. Chain brakes come in two varieties: hand-activated (set off when the forearm pushes against the hand guard as the saw snaps back), and inertia. The inertia brake works even if the operator's arm doesn't hit the hand guard. It has a specially weighted guard that tends to remain stationary as the rest of the saw spins backward. In both varieties, the hand guard trips a series of levers that releases a spring, tightening a band around the clutch drum to stop the chain (see cutaway at left).

To meet the safety standard, a brake must stop the chain before the saw has rotated 45 degrees. But the user may still be injured by the stopped chain, which looks

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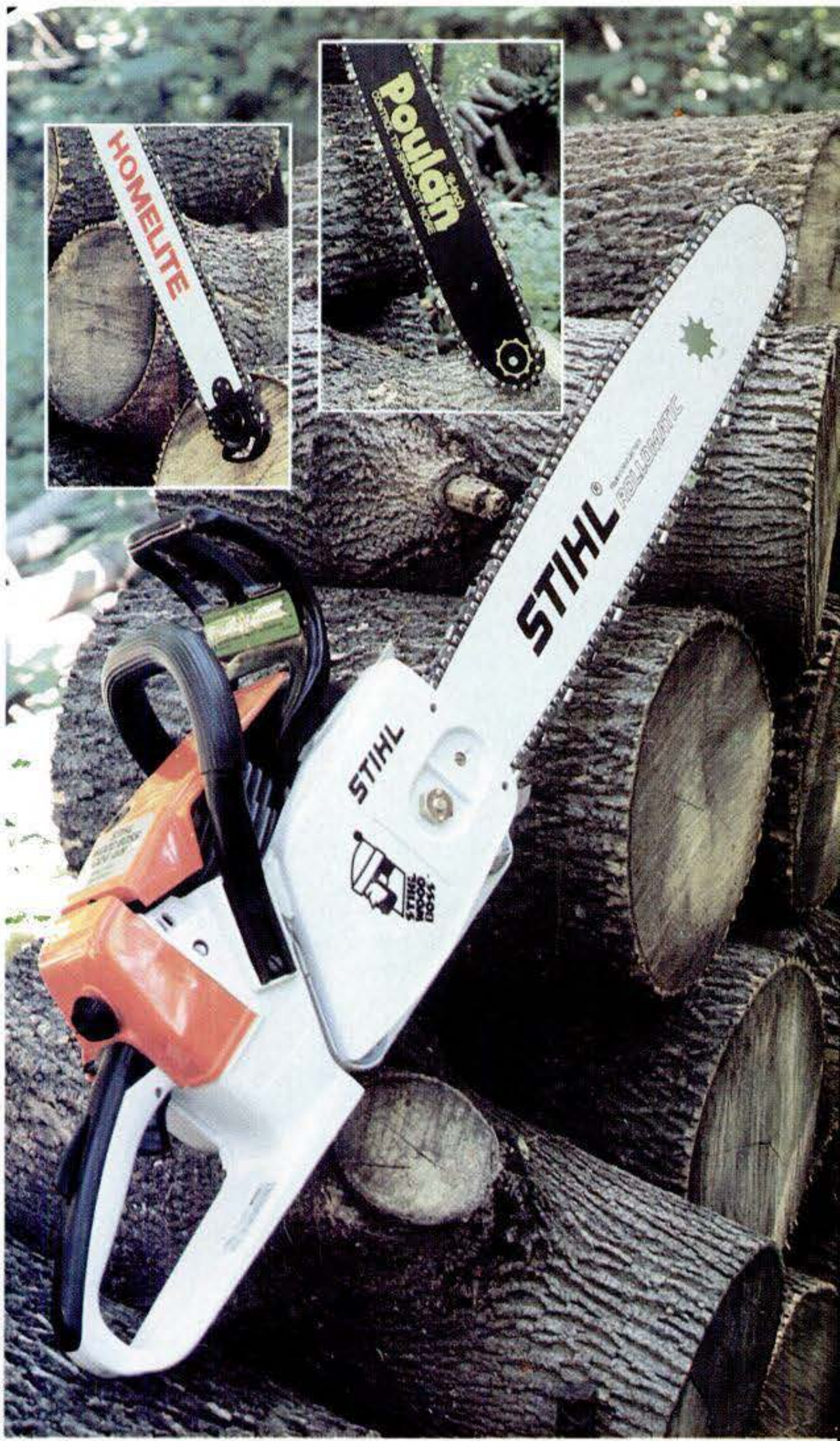
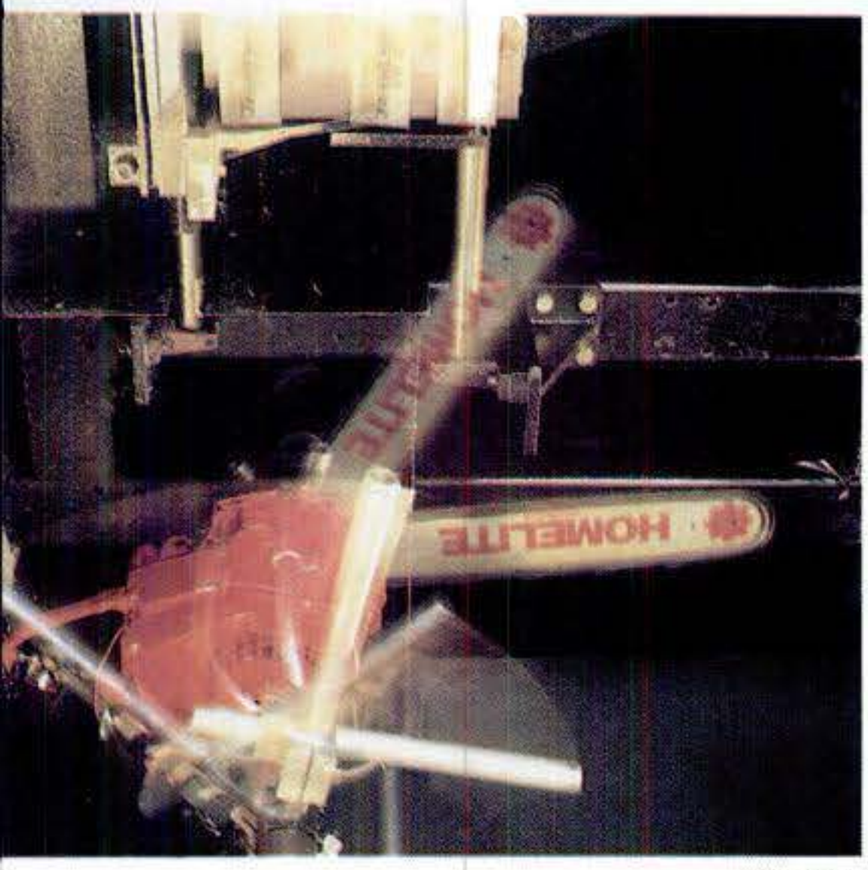
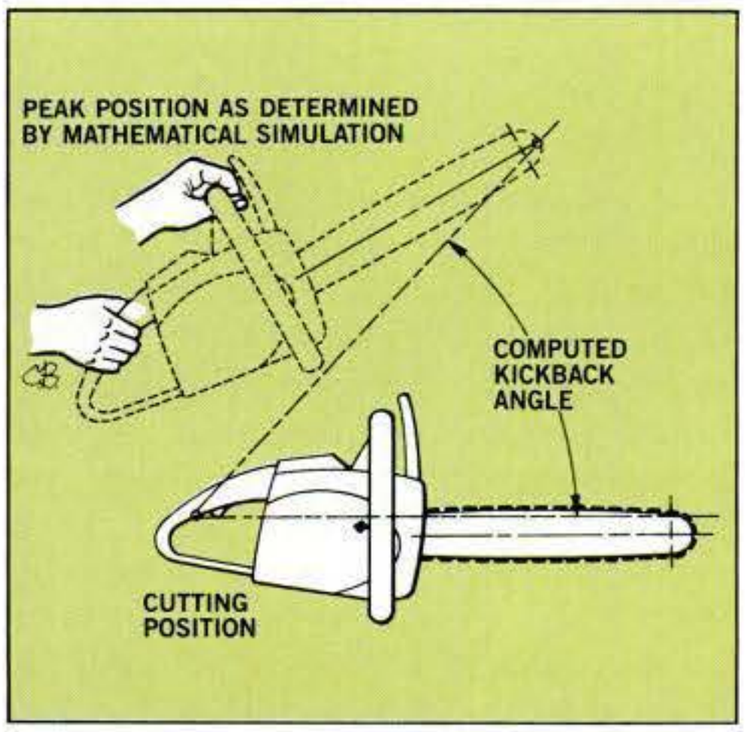



PHOTO BY GREG SHARKO

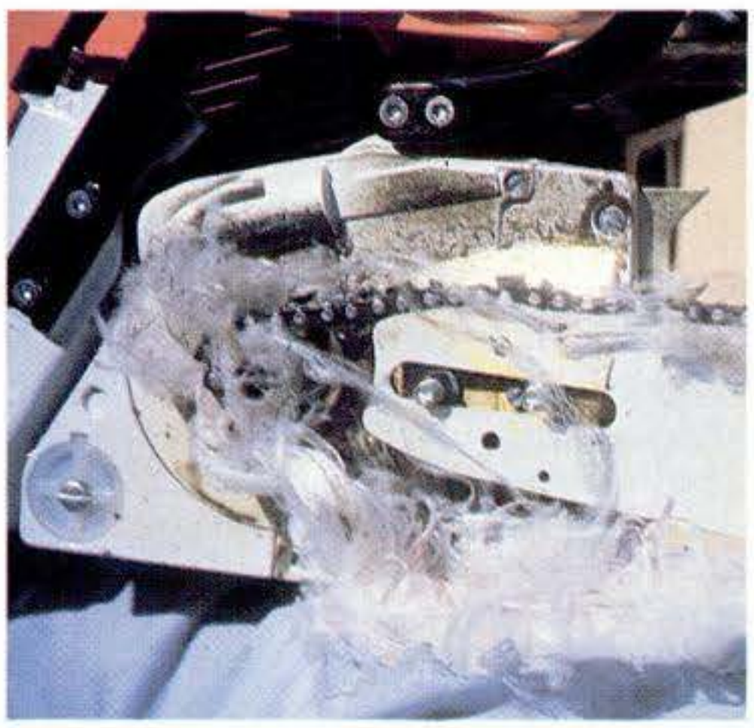
**Safety features: chain brake (connected to guard in front of handgrip) and narrow-nose bar on saw above, tip guard (left inset), banana nose (right inset), safety chain (all saws).**




HOMELITE




**Time exposure (left) shows a saw mounted in a machine designed to induce kickback. Distance is measured.**



**Polyester-fiber padding in Stihl protective pants is yanked into the saw's sprocket, which clogs and stops chain.**



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like a bicycle chain but cuts like a serrated knife.

Manufacturers have compared chain brakes to car brakes to make them seem like essential items. But Norman Beck, executive director of the National Equipment Servicing Dealers Assn., whose members sell and repair chain saws, says the analogy is unfair. "The only time you're ever going to find out it [the chain brake] doesn't work is when you need it," he says. It's difficult for an owner to tell whether the brake is working properly even if he tests it regularly. "It's got to work in such a short period of time that the average consumer has no idea whether it is stopping fast enough," says Mike Bounds, product safety manager for Beaird-Poulan, a domestic chain-saw manufacturer.

Two Canadian surveys, the 1979 Terry study and the 1982 Forest Engineering Research Institute of Canada (FERIC) special report, found that brake defects are common. The FERIC report discovered that "very few loggers had much confidence in the chain brake." And it warns that brakes might give consumers a false sense of security. "Chain brakes do nothing to eliminate the kickback danger zone; they merely try to reduce the effects once a kickback has been triggered," states the FERIC report.

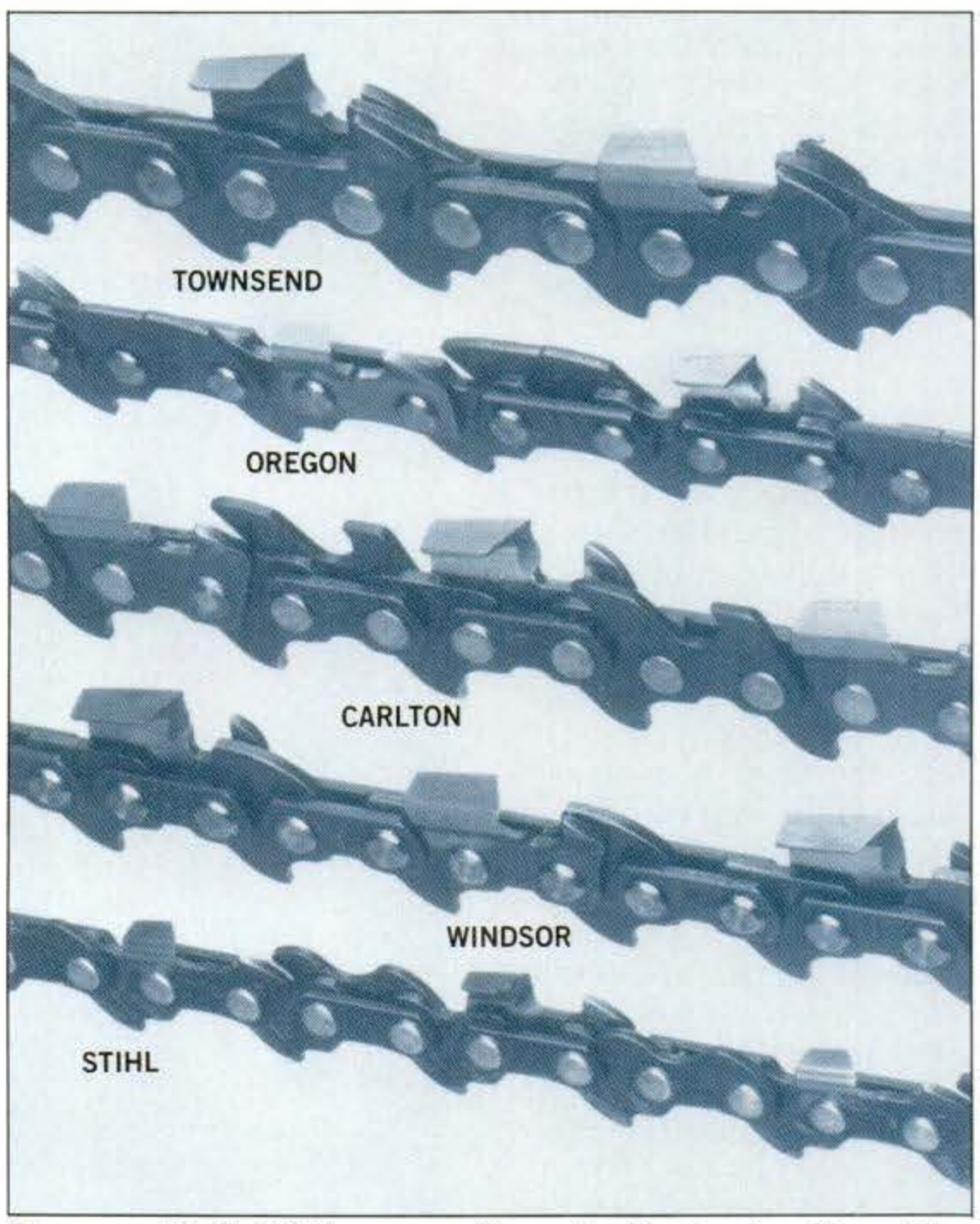
The Terry study notes that "in many instances the [brake] mechanism would not be positioned to activate even under severe kickback."

Despite the controversy, most manufacturers put chain brakes on all models. But there are some exceptions: Brakes are standard on some Homelite and Tanaka saws, optional on others. They're strictly optional for The Green Machine's saws, and Echo and Poulan don't offer them at all.

Another device that many manufacturers use is a reduced-kickback guide bar. There are two types, but the idea behind each is to reduce the upper quadrant of the bar's nose, where kickback occurs. One type is symmetrical and tapers to a narrow radius at the nose. The other type—the banana bar—also has a small radius, but its nose appears to curl upward (see photos).

Unfortunately, low-kickback bars (and chains) can be easily removed and replaced with more dangerous equipment. And some experts say that they may not last as long as regular bars. Dan Tilton, a chain-saw safety instructor for Tilton Equipment Co., distributor of Jonsered and Olympyk chain saws, says that the narrow-radius bars were rarely used when they first hit the market. "The chain tends to slap back and hammer the bottom rail, increasing the chances of derailing and breakage," Tilton warns.

Usually, when the bottom-rail groove wears out, the owner turns the bar over. But banana bars, because they are asymmetrical, cannot be flipped. "The customer loses fifty percent of the value of the bar," complains Vince Morabit, a technical consultant to the chain-saw industry. If the user does reverse the bar, it will be *more* hazardous than a bar that is not designed for low kickback.




**Townsend's Tri-Raker uses three depth gauges; the wider face keeps the chain from sticking. Windsor has one extra raker, on the drive link. Oregon adds a guard link to the tie strap, filling the space between cutters. Carlton and Stihl use cam-shaped guard links with tails that pivot outward as they go around the bar nose. All new chains have ramped rakers.**

The fourth feature, the bar tip guard, may be the most controversial. It *completely* precludes kickback, yet only two manufacturers use it on their saws. Morabit and a colleague invented the tip guard at Homelite in 1976, and the company offered the feature to the industry in 1979. But only Echo adopted it, introducing it this year.

"Technically, it is the best [chain saw] safety feature that was ever invented," admits Tilton, whose saws do not have the tip-guard feature. "But because the tip gets in the way, nine out of ten users will take it off before they ever use the saw," he notes. The tip must be removed to cut trees that are wider than the bar. And the saw must be lifted out of the kerf, not pulled back through it, after a cut.

Defenders of the tip guard say it helps keep the chain clean and allows the operator to cut in close quarters, and they argue that most owners aren't inconvenienced. According to a 1980 Homelite survey of 165 users, about two-thirds of those who had ever had the tip attached either never removed it or removed it and put it back on again. A CPSC telephone survey of 492 chain-saw users found that half of those who were provided with a tip guard always used it. About 36 percent never used it, and 12 percent sometimes removed it.

Why isn't the tip guard more prevalent in the industry? "There's a trade-off: a hundred percent safety as opposed to none [when the guard is removed]," says Norman Beck. "Most manufacturers don't want that all-or-nothing situation."

But Morabit and Paul Watson, manager of product safety at Homelite, claim that some manufacturers are unwilling to add tip guards now because it would be tantamount to admitting they did not provide adequate safeguards in the past. And because the tip guard *eliminates* kickback, it also eliminates any competitive advantages that a particular brake, bar, or chain design may have over its rivals.

Of course, none of the safety devices are infallible. Some are effective but can be inconvenient to use and may be removed by the user. Others may be less effective but are less intrusive. This is why the committee that developed the Standard decided to require at least two safety features.

By the end of 1987, the CPSC predicts, about one-third of the saws used by consumers will meet the Standard. The percentage is expected to increase to 80 by 1995. By that year, the CPSC projects, the new safety measures may have prevented more than 100,000 medically attended rotational kickback injuries. PS



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# Teak chic

Once, people bathed in wooden tubs. Then came California redwood patio hot tubs. Kohler now brings the warmth and rich-grained elegance of wood back to the bathroom with hand-crafted teakwood fixtures—each one unique.

By GENEVIEVE CAPOWSKI

It's been a long time since Americans associated wood fixtures with bathrooms—outhouses went out long ago. But now wood is back, and it was worth the wait.

Kohler's elegant Mandalay Teakwood Suite, including bathtub, lavatory, and toilet seat, surely doesn't compare with an outhouse, but then neither does the price—about $10,000 for the trio (sold only in suites), not including faucets and accessories.

Kohler designers (Kohler, Wis. 53044) wrestled with the concept of wooden tubs before coming up with these unusual designs. "We wanted a wood associated with water," says product manager Gene Carpenter, "and teak grows in water—swamp water. Boatbuilders use it in the decks of racing sailboats because it's dense, very fibrous, and fairly impervious to the elements."

The construction of each piece is complex, Carpenter explains. First, craftsmen take strips of kiln-dried wood, then they glue and mount them into a flat frame that creates the starburst pattern unique to the base of each tub. Hand-cut side boards are fitted together, cured for three days, then glued and left to dry. To carry the same starburst pattern through to the tub rim, craftsmen cut the rim out from the perimeter of the base.

Final assembly involves bonding the base and rim to the side boards, then sanding, Carpenter says. For additional strength, technicians reinforce the back of each fixture with fiberglass. Lastly, seven to 10 coats of acrylic urethane are applied to protect the wood and give it a glossy finish.

To maintain the surface luster, Kohler advises using nonabrasive cleaners. Gouges in the surface can be repaired with a kit that includes a container of acrylic urethane. PS

**The Mandalay Teakwood Suite from Kohler includes a 5- or 6-ft. whirlpool bathtub (shown in top and bottom photos), a pedestal lavatory (center), and elongated toilet seat (not shown). Optional wainscoting is also available.**



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Flex-Plus ENT is flexible and easily bent by hand for quick installation. When using ½-in. tubing, drill 1-in. holes at the center of each 2×4 stud.

This keeps the tubing safe from nail penetration on both sides. For long runs, two pieces of tubing can be joined with a quick-connect coupler.

# Now DIY home is easier and

Electrical nonmetallic tubing is to thin-wall conduit as plastic pipe is to sweat-soldered copper plumbing—it's faster and simpler for do-it-yourself jobs. And new type MC cable combines ease of installation with the protection of metal conduit.

# —*with flexible PVC conduit*

By RICHARD DAY

The National Electric Code (NEC) permits a number of kinds of wiring to be used in a home electrical system. Some are simpler than others; some protect the wires better than others. Now two wiring systems rate just about tops on both scores: They are easy to install, *plus* they give the conductors plenty of tough cover. Either can make new home wiring —particularly exposed wiring in your garage and basement—an easy job. Neither requires special tools, nor the touch of a pro. These systems are designed for the do-it-yourselfer.

Carlon's Flex-Plus Blue polyvinyl chloride (PVC) plastic electrical nonmetallic tubing (ENT) is easier to use than thin-wall conduit. It installs in one-third the time, can be cut with a knife, and can be easily bent by hand and manipulated through framing.

Ready/Clad's type MC cable protects the conductors better than does armored cable. Its internal wires are encased in a seamless extruded-aluminum sheath. This outer tube is flexible, can be cut with a knife, and is as easy to install as the usual nonmetallic cable.

How do ENT and MC systems work? How do you use them? First, the standard precaution applies: Be careful whenever you work with electricity (see safety tips at end of article).

## ENT

The blue ENT tubing, outlet boxes, and fittings are made of tough PVC. The ENT tubes come in ½-, ¾-, and 1-inch diameters in 6- and 10-foot lengths. (The most commonly used ½-inch-diameter ENT sells for $1.40 per 10-foot length.)

Plastic ENT provides no ground continuity, so a same-gauge bare or green-insulated equipment-grounding conductor must be included with the wires you feed through your runs. The ground conductor must be connected to every receptacle, switch, light fixture, and appliance. (Appliance grounding must conform to Article 250 in the NEC.)

Because all current-carrying conductors contribute heat, design temperature of the conductors you select must be no more than the 194-degree-F rating of the ENT system. If you choose from among the conductors shown in NEC table 310-16, the system will meet the code. Both of the widely sold types TW and THHN conductors are usable. As with any raceway, the number and size of conductors contained in ENT mustn't exceed 40 percent of its volume. Box fill is the



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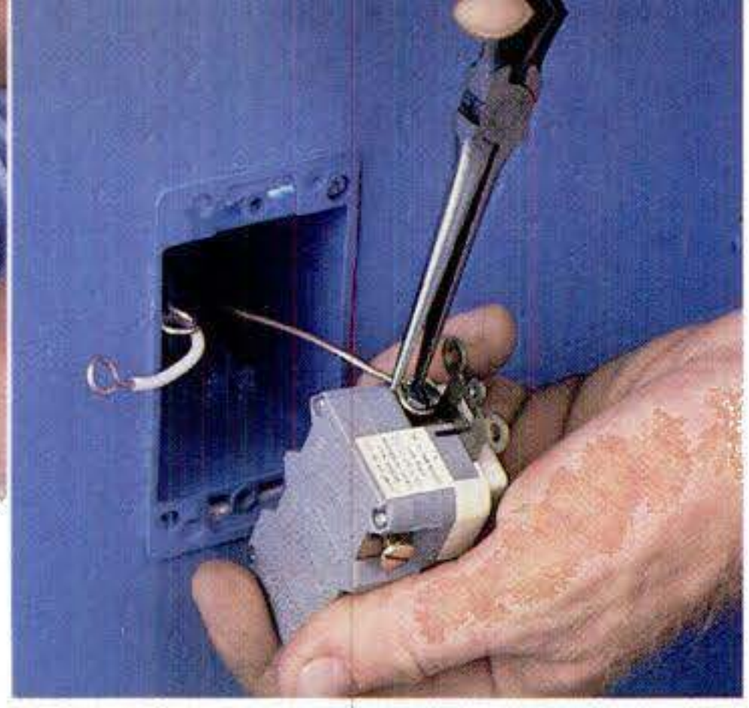


**Include a separate grounding conductor in each run to an outlet. The wire connects to the green hex-head terminal on grounding-type receptacles.**

# wiring safer

same as for metal boxes of the same size.

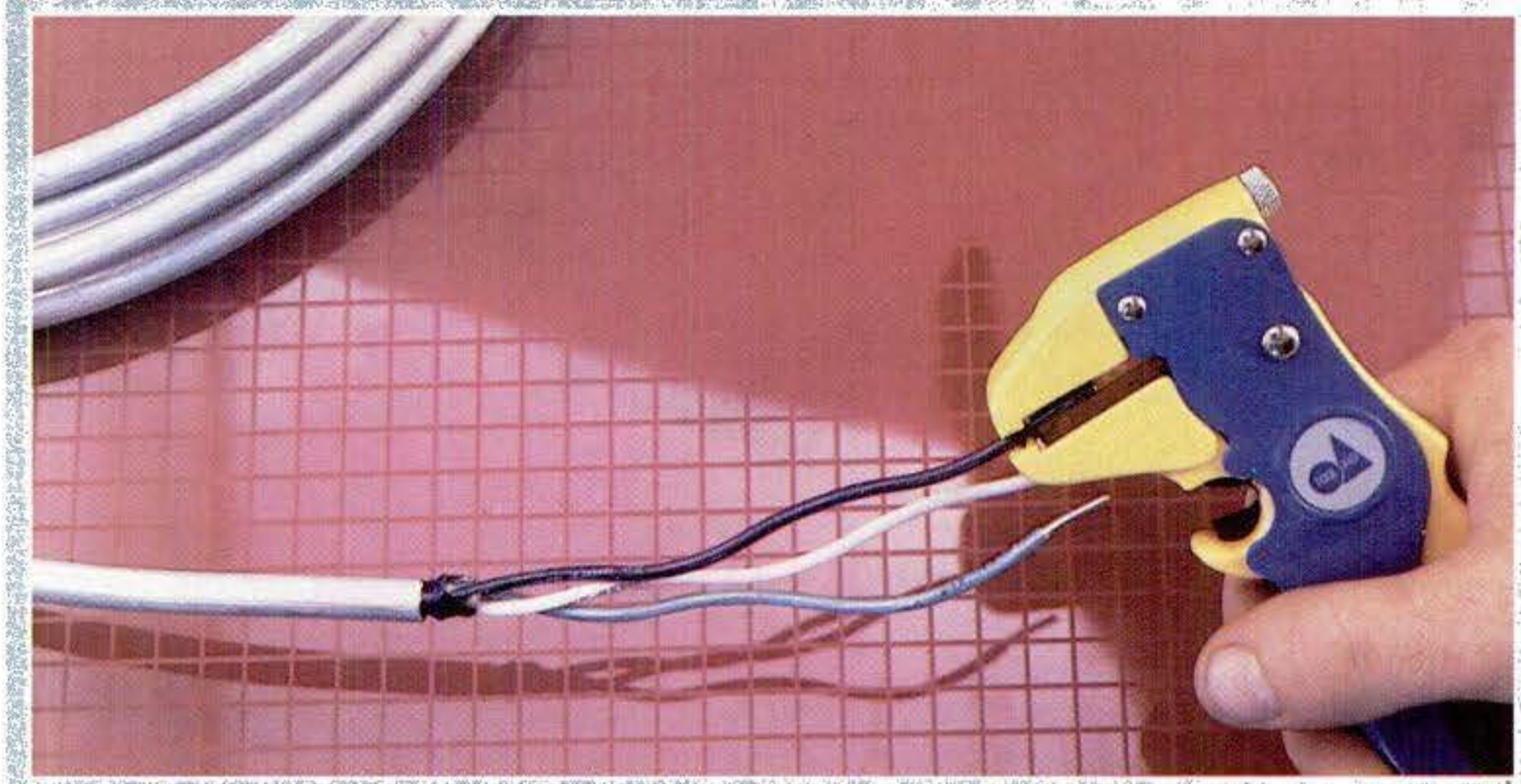
Flex-Plus ENT is ruled out for lighting circuits unless you use a metal box to hold the fixture. Reason: A plastic ENT box can't hold the weight of a fixture. Most metal boxes and panels accept ENT box terminators just fine. ENT won't work with threaded conduit pull-boxes or other tapped outlet boxes, such as weatherproof boxes. (Because a plastic box can't be grounded, never use plastic ENT boxes with metal conduit.)

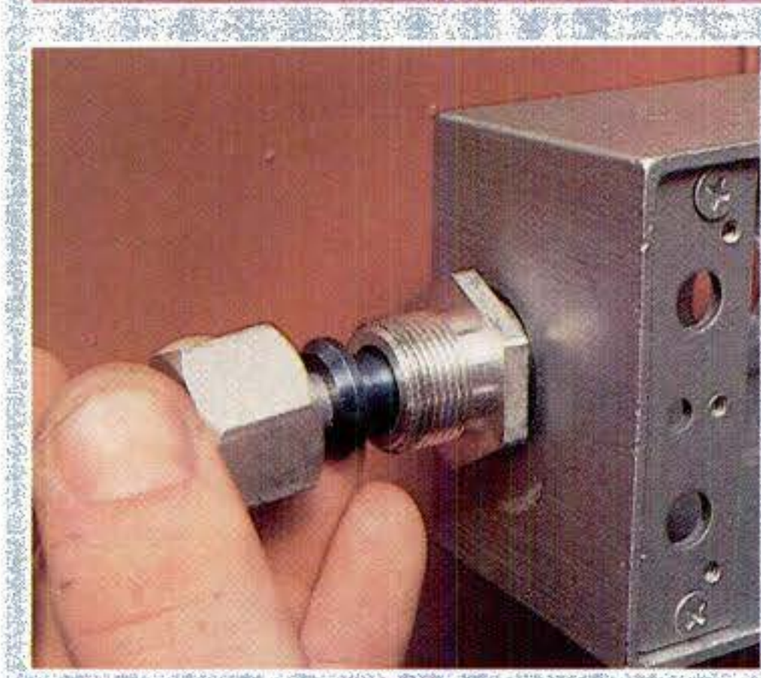
Installing ENT is easy. The boxes mount to the framing with nails or screws. I like to use short drywall screws. They're mostly self-threading, and run in quickly because they have twin threads. Carlon's ENT boxes contain ½-, ¾-, or 1-inch knockouts, depending on which box you select. Most wiring can be done with ½-inch ENT, especially if you use slender, nylon-insulated THHN conductors.

The two-by-three-inch switch-outlet boxes mount a convenient ½ inch out from the framing when the mounting straps are set flush (see photo). Thus, the boxes project through ½-inch wallboard to come through flush with the wall surface. The four-by-four-inch boxes mount even with the studs. This way, single or two-gang box covers can be used. Covers are available flat (for surface-mount use) or with pro-

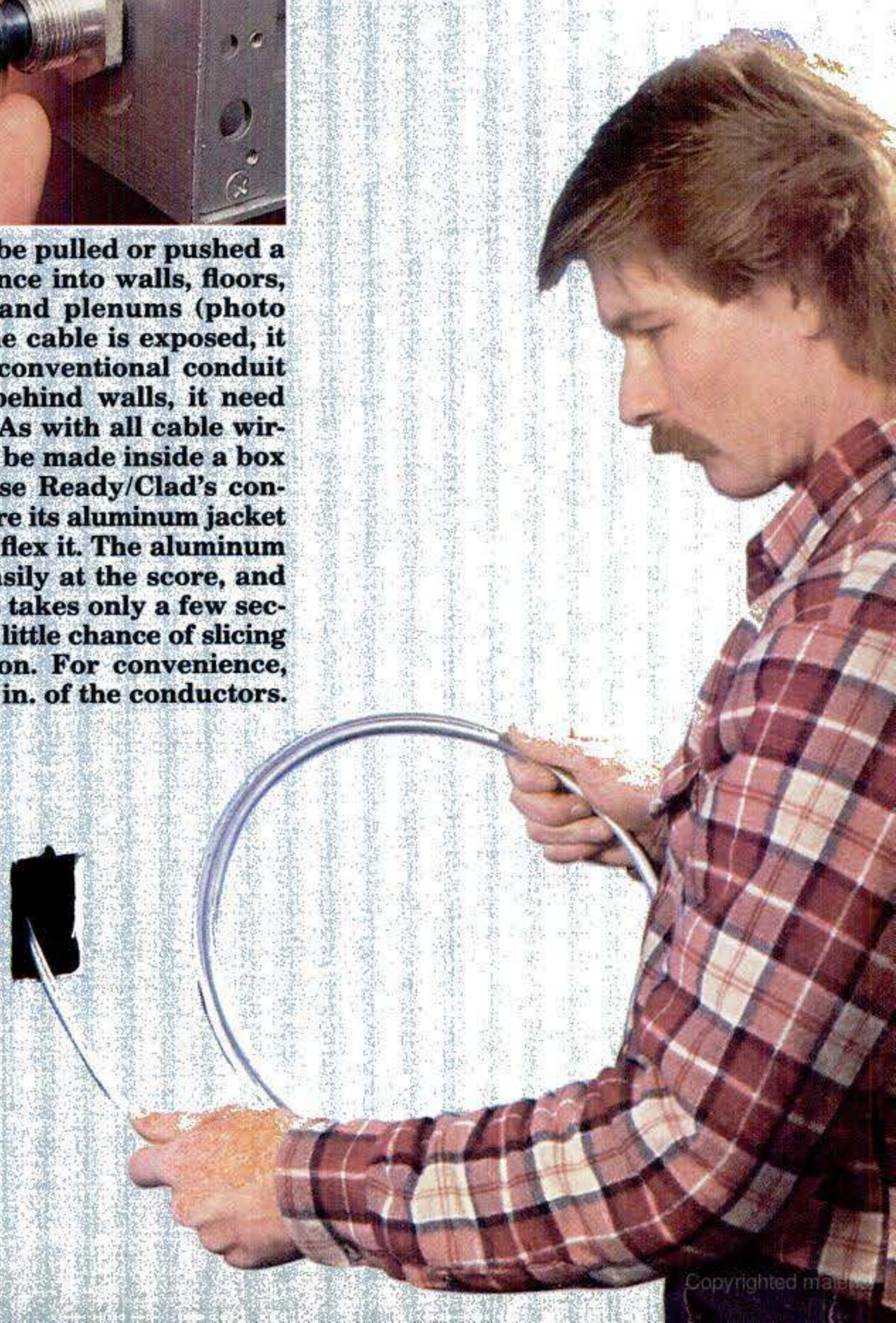
*Continued*

## —with new metal-sheathed cable





**Ready/Clad can be pulled or pushed a reasonable distance into walls, floors, ceilings, ducts, and plenums (photo below). Where the cable is exposed, it is secured with conventional conduit straps. Hidden behind walls, it need not be fastened. As with all cable wiring, splices must be made inside a box (above). To expose Ready/Clad's conductors (top), score its aluminum jacket with a knife and flex it. The aluminum sheath breaks easily at the score, and can be slid off. It takes only a few seconds, and there's little chance of slicing into the insulation. For convenience, expose at least 6 in. of the conductors.**



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## WHERE AND HOW TO USE ENT CONDUIT AND TYPE MC CABLE IN THE HOME

### ENT CONDUIT

**Permitted**
In one- to three-story houses inside walls, floors, and ceilings; also, most other dry and damp (partially protected) locations; OK for exposed work; boxes for walls only; maximum voltage: 600V

**Not permitted**
Hazardous locations or where exposed to weather; boxes not to be used to support fixtures; places that get hotter than 194° F; directly buried in ground or embedded in concrete or aggregates; where subject to physical damage

**Supports**
Maximum spacing 3′ and within 3′ of boxes; use nonmetallic clamps such as Carlon's E977 line

**Bending**
Bend by hand as needed; no radius less than ½″ = 4″, ¾″ = 5″, and 1″ = 6″

**Other**
Equipment grounding conductors must be provided within conduit runs where this is required by NEC Article 250; must also comply with applicable sections of NEC Article 300 on wiring methods

### MC CABLE

**Permitted**
For services, feeders, and branch circuits; for appliance, motor, lighting, and receptacle circuits; indoors and out; exposed or concealed; direct buried (with PVC-coated conduit)

**Not permitted**
Where exposed to corrosive conditions, unless protected by a material suited to them; where subject to physical damage

**Supports**
At intervals not more than 6′; staples suited to nonmetallic cable may be used

**Bending**
Minimum radius of inner edge of bend is 10 times the cable's outside diameter

**Other**
Box connectors should be identified for use with Type MC cable; must be installed to comply with NEC Article 300

DRAWING BY ELIOT BERGMAN

jections of ½, ⅝, ¾, or 1 inch. This enables them to extend through practically any thickness of wall material. A blank cover is available for a junction box.

Once the boxes are mounted, drill holes in the framing members for the ENT runs. The code requires that when the edge of the hole is closer than 1¼ inches to the face of the framing member, 1/16-inch-thick steel straps are needed to protect the wiring from possible nail penetration. Therefore, ENT sizes larger than ½ inch, when run in 2 × 4 stud walls, need plate protection at each stud.

Bends are made by hand. They must not be so sharp as to damage the tubing or effectively reduce its inside size. As with all raceways, four 90-degree bends per run (a total of 360 degrees between boxes) is the maximum allowed. This represents the limit for good wire-pulling. If you cut ENT with a plastic pipe cutter, there are no burrs to remove. If you saw them, you must use a knife to remove the burrs inside and out.

At some point you may have to connect the ENT to a knockout in an existing box or panel. No problem. The box terminator fits into a same-sized knockout. Once the wires are in, all four-by-four-inch box covers may be installed using the furnished screws.

## MC cable

The NEC refers to new Ready/Clad as type MC cable (Article 334). This pre-wired, aluminum-sheathed electrical cable can be used in exposed or concealed locations, and it's UL-listed for indoor and outdoor use. (Professional electricians use a similar material by another name: Signa/Clad.) If PVC-coated MC cable is used, the cable can be buried in the ground or cast within a concrete wall or slab.

The widely used 12/2 Ready/Clad cable costs slightly more than what's needed for a typical conduit system. But it's easier and faster to use: Unlike conduit, MC cable needs no joint every 10 feet. The runs are continuous between boxes. And the only tools you'll need are wire cutters, a knife, and a screwdriver—put away the hacksaw and pipe cutter.

The metal jacket of an MC cable serves as its equipment-grounding conductor. The sheath replaces an internal ground wire, but *metal* boxes and connectors must be used for good ground continuity. To ensure a sound electrical contact between connector and sheath, PVC-coated MC cable must have its outer coating removed wherever it enters box connectors.

Ready/Clad cable is slimmer than nonmetallic cable of the same current-carrying capacity. A cable containing two 12-gauge insulated conductors—a black and a white—is only about ⅜ inch in diameter. This is the size you'd use for wiring a 20-ampere household receptacle or lighting circuit. A cable containing three six-gauge conductors is about 1¼ inches O.D. This size might be used for wiring a branch circuit-breaker panel.

Ready/Clad cable is available from some hardware stores and home centers, and from electrical-supply dealers in three packaged lengths: 25, 50, and 100 feet. A supply of straps and dry-location box connectors comes with each package. The 25-foot two-wire/12-gauge package costs about $20.

## Safety tips

Use caution whenever you're working on your home's electrical system. Turn off the circuit by switching off its circuit breaker or unscrewing its fuse. (The main fuses or circuit breaker should be off when handling fuses.) Call your electric utility to cut off all power before you open a main panel.

Never touch a bare wire unless you are absolutely certain it is dead. (Touch it to a ground post to be sure.) Because there could be more than one circuit inside a box, check to see that *all* its circuits are off before continuing. Make sure your house wiring has the capacity to handle any add-ons that you make.

Check and adhere to all local electrical codes and to the NEC. Get a permit for your wiring, and have your work approved by an electrician. A copy of the latest NEC can usually be found at the public library.

Finally, although home wiring is relatively easy, if you're not absolutely sure of your electrical-wiring capabilities, hire a pro. PS

**MAKERS**

**Carlon Electrical Sciences** (ENT), 25701 Science Park Dr., Cleveland OH 44122; **Electrical Conductors** (Ready/Clad), 2500 Commonwealth Ave., North Chicago IL 60064



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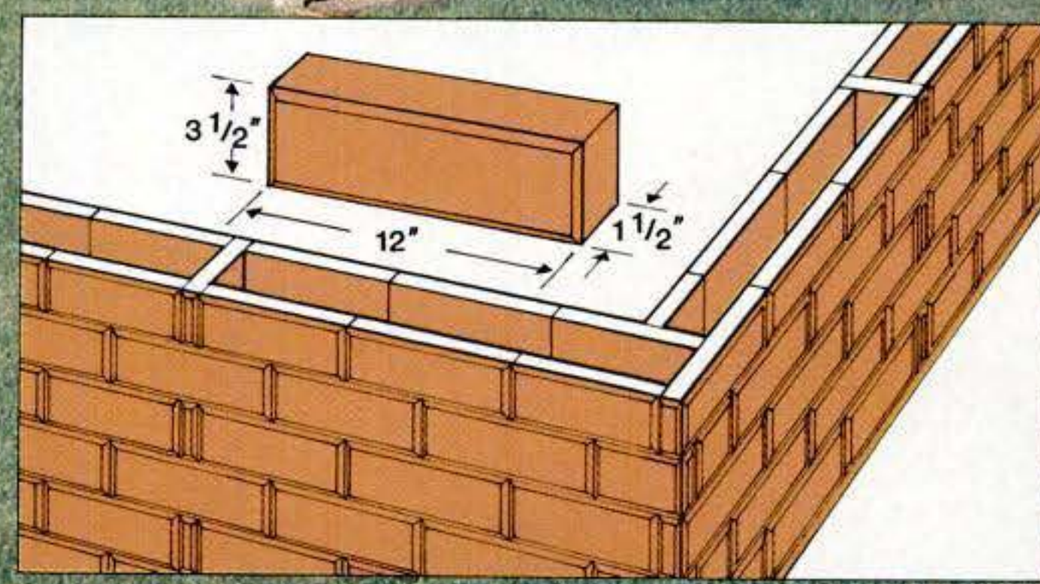
# Glued-together house




Whitewashed brick? Not exactly. This reader built his house of "bricks" he cut from 2 × 4s. The result: a 1,500-square-foot house that cost only $33,000—plus plenty of sweat.

**By V. ELAINE GILMORE**

Sometimes inspiration comes from unlikely quarters. For Beau Talbot III, it sprang from a huge volume of 2 × 4 scraps produced by a truss mill near his Pine Bluff, Ark., home. "Why not use the scraps to make wooden bricks?" Talbot reasoned. His son, Beau Talbot IV, went further: "Why not build a wood-brick house?"

Six months, 8,500 bricks, and about 2,500 man-hours later—mostly his own and his father's—Beau Talbot IV, along with wife, Elizabeth, and children, Lauren and Jefferson, moved in to what may be the world's first wood-brick house. The walls are double, tied together regularly by bricks laid perpendicular to the courses. A 2½-inch space between walls is filled with cellulose insulation. Faces of the bricks are beveled. The "mortar" is a construction adhesive called Liquid Nails, made by Macco Adhesives of Wickliffe, Ohio.

Total cost of the finished 1,500-square-foot house was $33,000: $22 per square foot. A similar conventional house would cost $33–$38 per square foot, the younger Talbot says. "My house was appraised at $51,000. That means I have $18,000 equity in it—all sweat." He doesn't laugh.

As with most first-of-a-kind projects, this one threw several curves at the builders. The truss-mill owner offered the 2 × 4 pieces for only $10 a truck load, "if you load them." But that meant sifting through the scrap heap and loading the truck by hand. So the Talbots bought some lumber from a lumber mill. "We paid $120 per thousand board feet for *shorts*, boards less than eight feet long," says Talbot senior. "Those we could load with a fork lift."

Their biggest problem was keeping the brick courses plumb. "One end wall has a visible wave in it," the younger Talbot reports. Now his father has come up with a groove-and-spline system to keep the courses aligned. In August he carted saws and glue to a new site and began his own new, improved wood-brick house. PS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# Shredder showdown

## —the leaner, meaner, more-efficient garden cleanup machines

The days of the bulky monster grinder of only a few years ago are over. Today there's a shredder for everyone—from tiny electrics for the weekend gardener to 8-hp workhorses for the serious landowner. And they're lighter, more compact, and more sophisticated, too.

**By TIMOTHY O. BAKKE**
*Photo by Greg Sharko*

The garden shredders I'd been waiting for had arrived. I was familiar with shredders—large, clumsy contraptions that mashed just about anything you put in them. They became common in the early '70s, when organic gardening was popular. But the ones I have here are different.

One looks like a colossal yellow food processor. Another has a three-legged offset stance, with the motor and the feed chute meeting in an oblique V-shape. Yet another looks like an orange upside-down top hat, while a fourth has a small green plastic housing and looks like a toy.

These machines are the newest shapes in shredders. A recent spate of imported models has shaken the shredder industry. Now there are more—and better—machines to choose from. There are small electric models designed for homeowners who don't need—or want—larger machines. Despite their size, the little electrics make impressive performance claims. There are mid-sized gasoline-powered models (3–5 hp), one of which has taken a radically different approach to shredding. Then there are the larger gasoline-powered machines for landowners who have large gardens and heavy shredding requirements.

Are these new machines really different? Do they deliver when put to the task? Or is it all just surface glitz? I took a close look at eight shredders in a variety of sizes to see how they were different—both from their predecessors and from each other. Then I put them to work to see what they can—and can't—do.

In the past, shredding has typically been done by gasoline-powered machines using the hammer-mill method: A number of free-swinging steel flails connected to a horizontal rotating shaft chop debris with brute force against hardened-steel grate bars and a sizing screen. Some machines still use variations of this method, but other approaches have now come into use.

The Steinmax 1800, for example, has cutting blades mounted on a vertical shaft so that it shreds like a blender. It also has a chipping blade with a separate feeding tube. The little green Mantis Chipmate uses two planer blades mounted on opposite sides of a horizontally rotating cylinder to slice material against a steel stop. The three-legged Lescha Zak 1800 has a vertically mounted flywheel with a steel cutting blade. Material is pushed against the face of the spinning flywheel so the blade can slice it guillotine-style. Unlike the Steinmax, neither the Chipmate nor the Lescha has a separate chipper.

All the electrics shredded twigs and heavy weed stalks well. It was a different story when I put through heavier branches, though. The Steinmax claims a 1¼-inch capacity for chipping branches. But twice when I put through limbs approaching one inch, the machine jammed and had to be disassembled.

The toylike Chipmate performed better than I expected. It also claims a 1¼-inch capacity, and it attacked small branches with surprising vigor. As the sticks got thicker, one inch in diameter and more, however, strong vibrations kept shutting the power switch off.

The Lescha was the best performer. It aggressively swallowed branches up to one inch thick. Thicker branches bogged down the motor, but I could ease the machine through anything up to its 1¼-inch capacity.

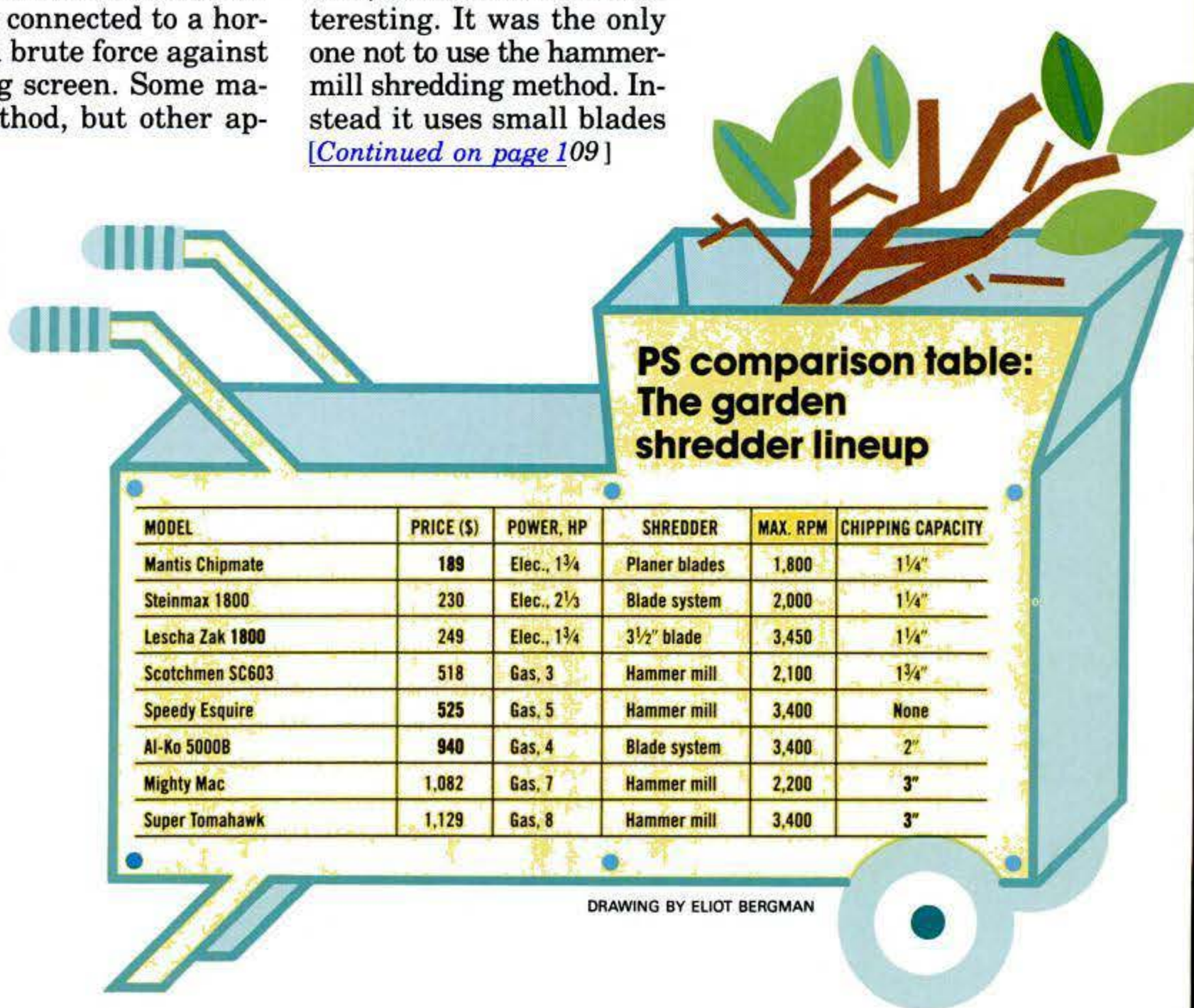
Of all the gas-powered models, the yellow Al-Ko Kober 5000B, the Austrian import with its radically different look, seemed the most interesting. It was the only one not to use the hammer-mill shredding method. Instead it uses small blades

[Continued on page 109]

**Wood chips, anyone? They can't make a mountain like this, but the new crop of shredders is better than ever: Speedy Esquire (1) also comes without a motor if you have your own power source. Super Tomahawk (2) is a compact heavyweight. Steinmax 1800 (3) is imported from West Germany. Austrian-made Al-Ko Kober 5000B (4) looks like a backyard Cuisinart; Lescha Zak 1800 (5), also from West Germany, is a powerful lightweight. The Mighty Mac (6) can take on 3-in. branches; the Scotchmen SC603 (7) is a gas-powered middleweight. Lightest of the bunch, the Chipmate (8), worked surprisingly well.**

**FOR MORE INFORMATION ON GARDEN SHREDDERS**

**Al-Ko Kober Corp.**, 25784 Borg Rd., Elkhart IN 46514 (5000B); **Amerind MacKissic**, Box 111, Parker Ford PA 19457 (Mighty Mac); **Garden Way Mfg. Co.**, 102nd St. and Ninth Ave., Troy NY 12180 (Super Tomahawk); **Gardener's Supply Co.**, 133 Elm St., Winooski VT 05404 (Lescha Zak 1800); **The Kinsman Garden Co.**, River Rd., Point Pleasant PA 18950 (Steinmax 1800); **Mantis Mfg.**, 1458 County Line Rd., Huntingdon Valley PA 19006 (Chipmate); **Scotchmen**, RD 1, Pottstown PA 19464 (SC603); **Winona Attrition Mill**, 1009 W. Fifth St., Winona MN 55987 (Speedy Esquire)



**PS comparison table: The garden shredder lineup**

| MODEL | PRICE ($) | POWER, HP | SHREDDER | MAX. RPM | CHIPPING CAPACITY |
|---|---|---|---|---|---|
| Mantis Chipmate | 189 | Elec., 1¾ | Planer blades | 1,800 | 1¼" |
| Steinmax 1800 | 230 | Elec., 2⅓ | Blade system | 2,000 | 1¼" |
| Lescha Zak 1800 | 249 | Elec., 1¾ | 3½" blade | 3,450 | 1¼" |
| Scotchmen SC603 | 518 | Gas, 3 | Hammer mill | 2,100 | 1¾" |
| Speedy Esquire | 525 | Gas, 5 | Hammer mill | 3,400 | None |
| Al-Ko 5000B | 940 | Gas, 4 | Blade system | 3,400 | 2" |
| Mighty Mac | 1,082 | Gas, 7 | Hammer mill | 2,200 | 3" |
| Super Tomahawk | 1,129 | Gas, 8 | Hammer mill | 3,400 | 3" |

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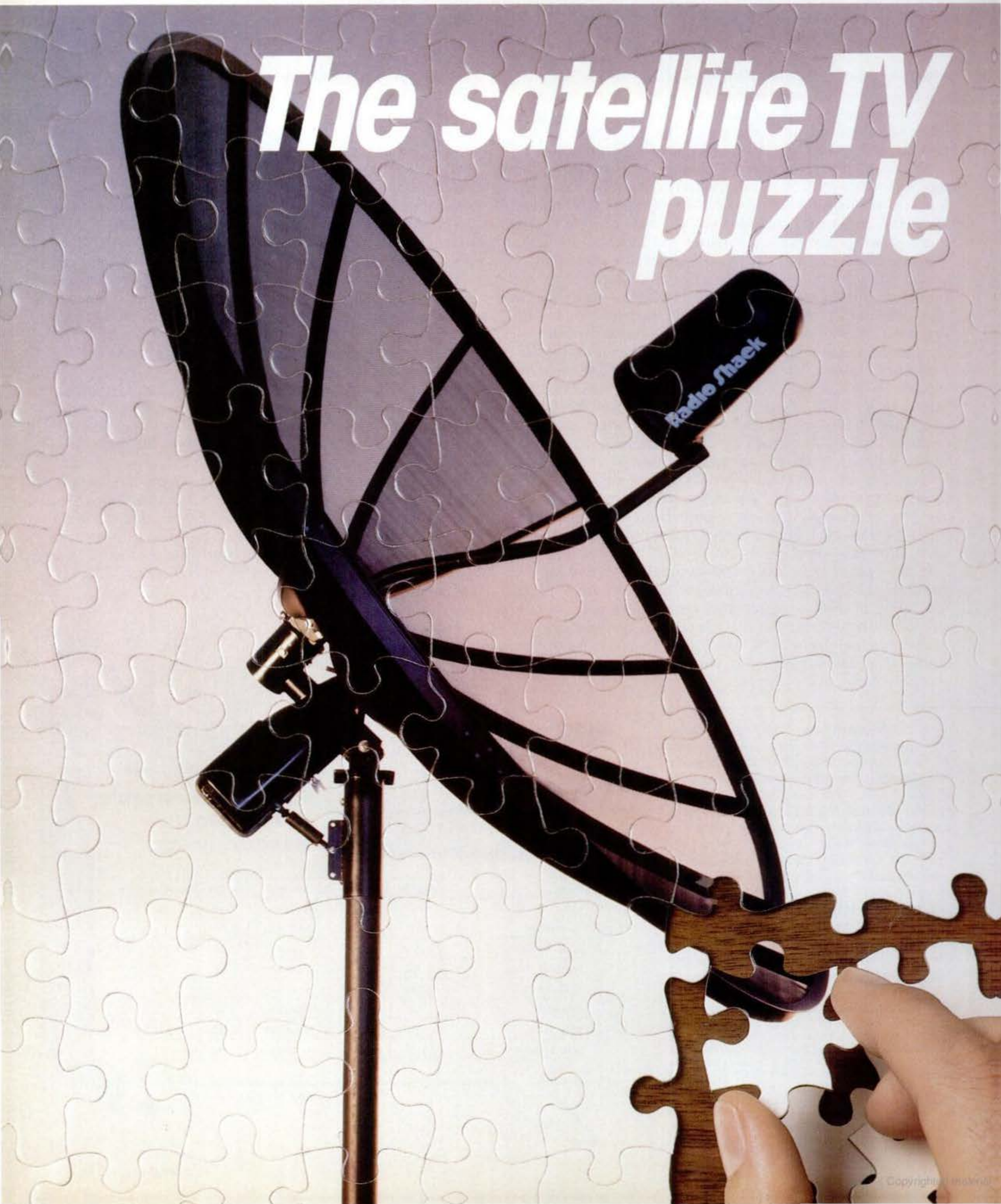
**Beginning here: Special section on HOME ELECTRONICS**

# The satellite TV puzzle



Tiny TVs fit in your hand and go with you—anywhere. Compact discs leave the living room and settle comfortably in your car's instrument panel. And a computer—complete with keyboard, memory, and display—is now made for your wallet. It's a credit card that takes credit for lots more than just instant buying power: It keeps track of addresses, health-care data, and other personal records. These are just samples of what you'll see in this special section devoted to home electronics. And what could be closer to home than your backyard: Beginning here, learn how scrambling has changed the picture on the home satellite TV industry.

When Home Box Office and Showtime decided to scramble their signals, it looked like the skies would soon be dark. Now descramblers are available, and new marketing strategies have begun to bring the price of "bird watching" back down to earth. It's unlikely satellite antennas will ever be used as birdbaths, but some channels may never again be open to home viewers.

**By DAWN STOVER**
*Photo by Peter Lerman*

Diane Davis and her family live at the base of Pilot Mountain in the Ozarks, surrounded by spring-fed streams and rugged hills covered with red and white oaks. The nearest town is St. Joe, Ark., and it's only "a wide spot in the road," says Davis. Little Rock lies 125 miles overland to the south.

The Davises live in a "white area," but the name doesn't come from the region's limestone bluffs. White areas are parts of the country where terrain or distance wipe out television signals. The Davises don't get ABC or CBS at all. They sometimes tune in an NBC affiliate station in Springfield, Mo., but temperature inversions garble the picture in the spring and summer.

To join the TV age, the family bought a satellite dish two years ago. Now Diane, her husband, and her daughter get all three networks. Until January, they could also view all 75 to 100 channels of satellite programs at no charge—including shuttle launches, children's shows, most major sports events, and about 650 movies a month.

Into this happy scene dropped last January's bombshell: Home Box Office (HBO) began scrambling its signal. Showtime, another so-called "premium" channel, followed suit, and so did other satellite programmers. The result: widespread confusion and anger. Sales of satellite dishes plummeted, and some companies went out of business. Most of the country's 1.5 million dish owners let out howls of rage that reverberated in the halls of Congress.

HBO and most of the others who are scrambling decided to make their programs available to individual dish owners. But those owners howled anew, saying the proposed prices were outrageous and the arrangements clumsy. Now, almost a year later, the situation, though still beset by many uncertainties, is becoming a little clearer. A number of retailing schemes that will allow antenna owners to watch satellite TV have been proposed, and some are in place. The technology to descramble programs is in hand and available on the market. Program prices are coming down. Rumblings of regulations to benefit home viewers are still heard from Washington. In recent months I have talked with dish owners, satellite TV company executives, government officials, and many others with an interest in the situation. Here is where we stand now, and the best guesses on future developments.

## In the beginning

H. Taylor Howard is the director of research for Chaparral Communications and the chairman of SPACE (Society for Private and Commercial Earth Stations), the satellite trade association. (SPACE has also been dubbed the "Society Plotting Against Cable Executives.") Howard built the first satellite dish from an old 15-foot microwave antenna (it still works). On Feb. 14, 1976, he tuned in HBO, a company launched in 1972 to transmit sports and entertainment specials and hit movies—uninterrupted by commercials—to cable TV companies. The cable companies, of course, sold the service to cable subscribers, charging them a premium over the regular monthly fee (thus establishing HBO as a premium channel). Later that year, Howard told the company he was picking up the signal and offered to pay a monthly fee, but HBO never responded.

Other people who knew something about electronics began putting together what quickly came to be called earth stations, and by 1979 Neiman-Marcus, the elegant Dallas department store, was advertising a setup for $36,000. But prices came down steadily, and in the ensuing years people who lived in rural areas that would never be wired for cable began ordering antennas. When prices fell further still, a few suburbanites invested in the new technology [PS, March '80, Nov. '81, Aug. '83, Dec. '84, Dec. '85]. It is now possible to purchase and install an earth station for under $1,000 [PS, July '84, July '85, Nov. '85]; see box with this article.

The industry was growing rapidly, with more than 600,000 dishes sold in 1985 alone. Then came scrambling. Dish sales dropped from 90,000 per month in September 1985 to 16,000 in February, and about one-half of the dealers have gone out of business this year, according to SPACE.

## Why scrambling?

Programmers such as HBO and Showtime claim they decided to scramble to thwart "pirates"—cable companies who weren't paying their bills, and hotel and condominium operators who were intercepting the signal and selling it. But they also had another motive: The satellite TV industry was created to supply—and be paid for—programs for the cable industry. The programmers are "cable friendly" because cable franchises have the infrastructure needed to net a large volume of subscribers. So when cable companies began to grumble about the antennas sprouting in the suburbs, the programmers paid attention.

In 1982, HBO announced that it would eventually begin scrambling its transmissions. Selecting from several possible systems then available, it decided on a system developed by a company called M/A-Com Inc. Most other programmers—with the exception of a few Canadian enterprises—have also settled on the M/A-Com system. Thus one descrambler decodes most programming.

The device developed by M/A-Com is called VideoCipher II, and it's sold by M/A-Com and Channel Master for about $400. The system is ingenious.

*Continued*



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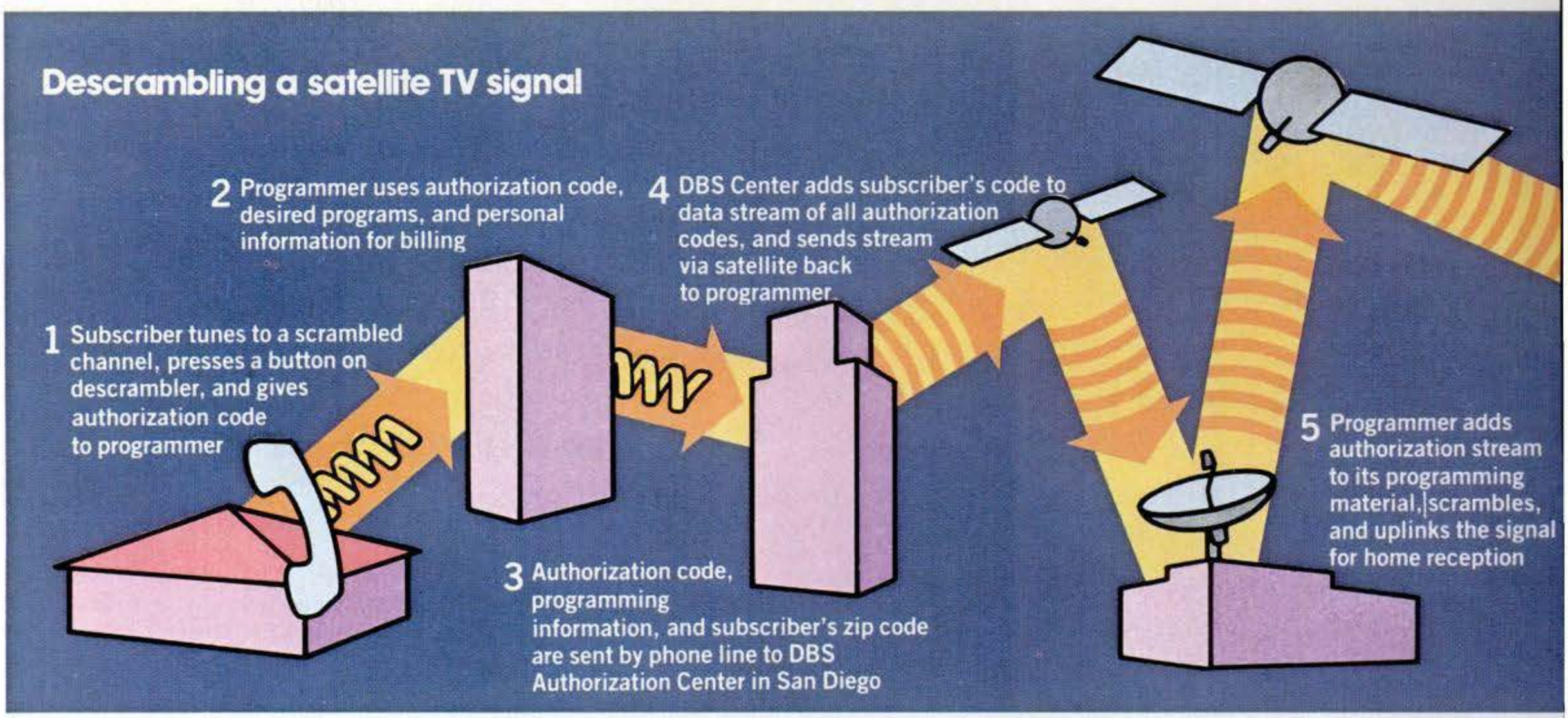



Simply buying a descrambler doesn't automatically let you tune in scrambled programs; that would defeat the whole purpose of scrambling. Here's how it works: Once you have a descrambler, you get in touch with a programmer such as HBO—either directly or through your local cable company. You agree to pay a monthly fee, and HBO adds you to the authorized list. Then every few minutes, sandwiched in between other information on the regular satellite signal, HBO transmits an authorization code that turns on your descrambler. HBO also beams up codes for all the other authorized descramblers in the country.

Forget to pay your bill one month, and your number is removed from the list. Your descrambler no longer works on HBO transmissions (for complete details, see box, next page). All you'll see is a mass of wavy lines on your screen, and you'll hear a voice-over that tells you how to become a subscriber.

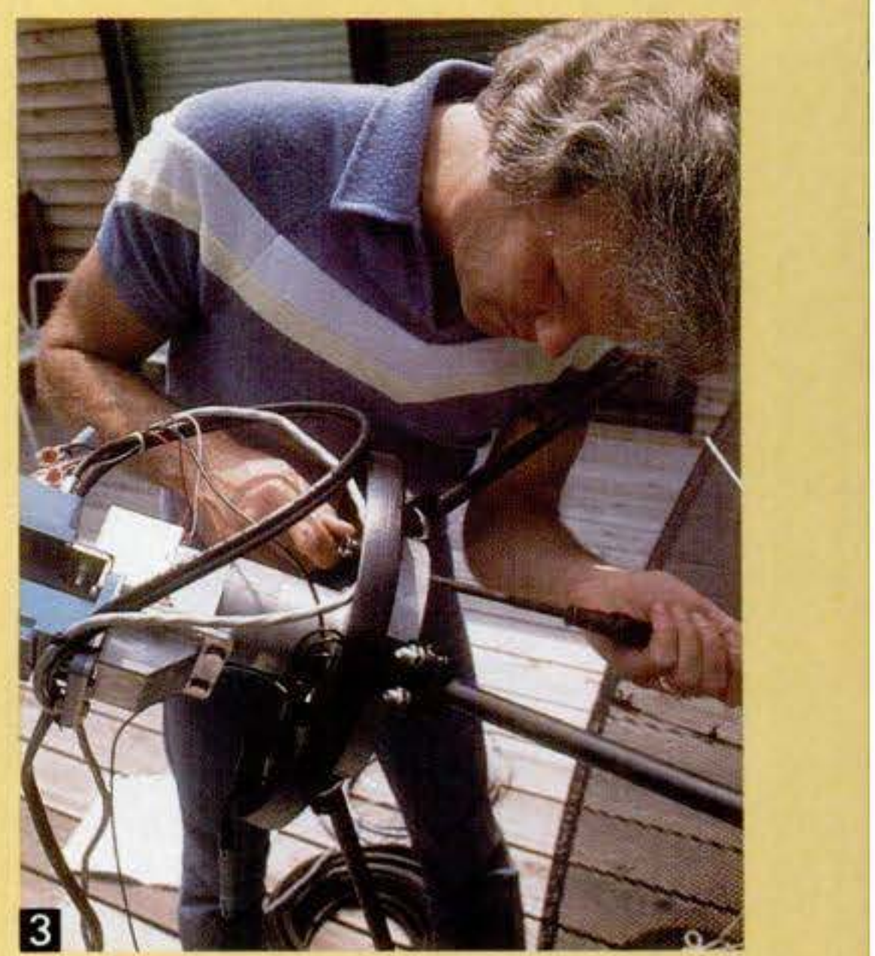
No one knows how many channels will ultimately be jumbled. HBO and its companion service, Cinemax, were the first to scramble, of course. Their rivals, the Showtime-The Movie Channel duo, were next. And Cable News Network (CNN) scrambled in early summer. About 20 signals will probably be obscured within the next year, including the popular all-sports ESPN and The Disney Channel. Alfred Sikes, assistant secretary of commerce, says more than half will be scrambled within 18 months, and "some experts maintain all of them will be scrambled by the end of the decade."

Even some ad-supported stations will scramble at the cable industry's

## Installing Drake's patio-mount system

One of the newest home satellite dishes uses a patio mount. Unlike other antennas, such as the Radio Shack shown in the lead photograph, the Drake Series 1 at right is not permanent, and it does not use a motor for positioning. Although the antenna must be aimed by hand, its advantages over others are lower cost (under $1,000 for antenna and receiving system, but not a descrambler) and quick installation. What you'll need: screwdriver, pliers, open-end wrenches, possibly extra hardware (my kit was missing some), a *good* compass (the one in the kit didn't work), and a second person. The 6-ft. mesh-screen dish comes in six sections; a set of three sections is bolted together first (1), then added to the second set. Temporary strings placed across the dish should lightly touch in the center when all sections are of equal height. All bolts are tightened starting from the center of the dish and working outward to avoid buckling. Three support rods to hold the feed horn are attached to the outer rim. The triangular patio mount (2) props up the antenna. Legs on the mount are adjustable (like tent poles) to change the antenna's elevation angle. The pre-wired feed horn (3) attaches to a mounting bracket on the support rods. Its two cables (signal and power) attach to the rear of the receiver (4); the receiver connects to the VHF antenna terminals of the TV set. Aiming the antenna properly is crucial. Like other satellites, the Galaxy 1 we tried to receive is a mere pinpoint in the sky, some 22,000 miles up. The elevation is set by adjusting the support legs and reading an inclinometer (a degree-marked metal plate with a hanging pointer) that's mounted on the rear of the antenna. The antenna's direction is set with the compass. Result: "Beginner's luck," said a spokesman for Drake. Although accurately aiming the system could take hours, we *immediately* saw a clear, nearly sparkle-free picture. Total setup time: about 4 hrs.—W. J. Hawkins

1


3



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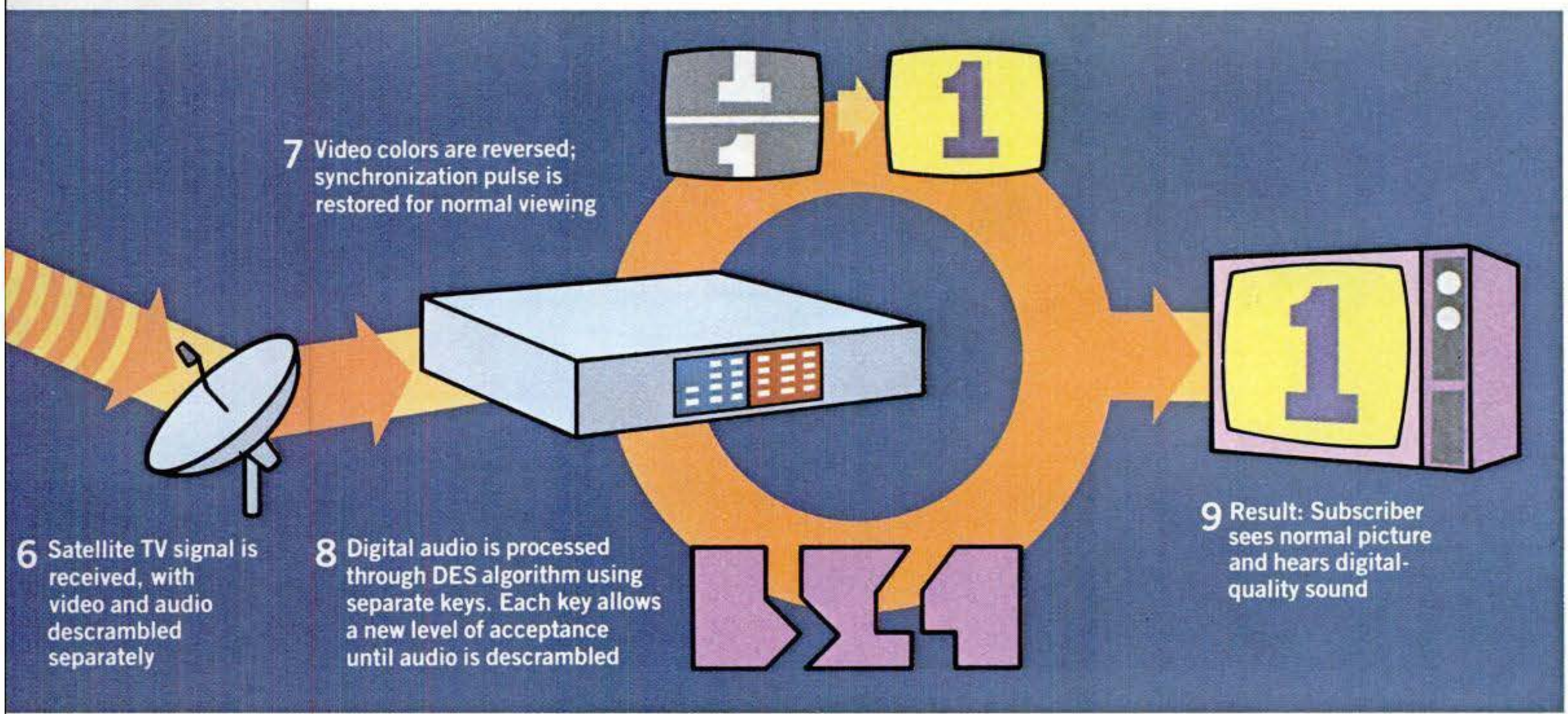
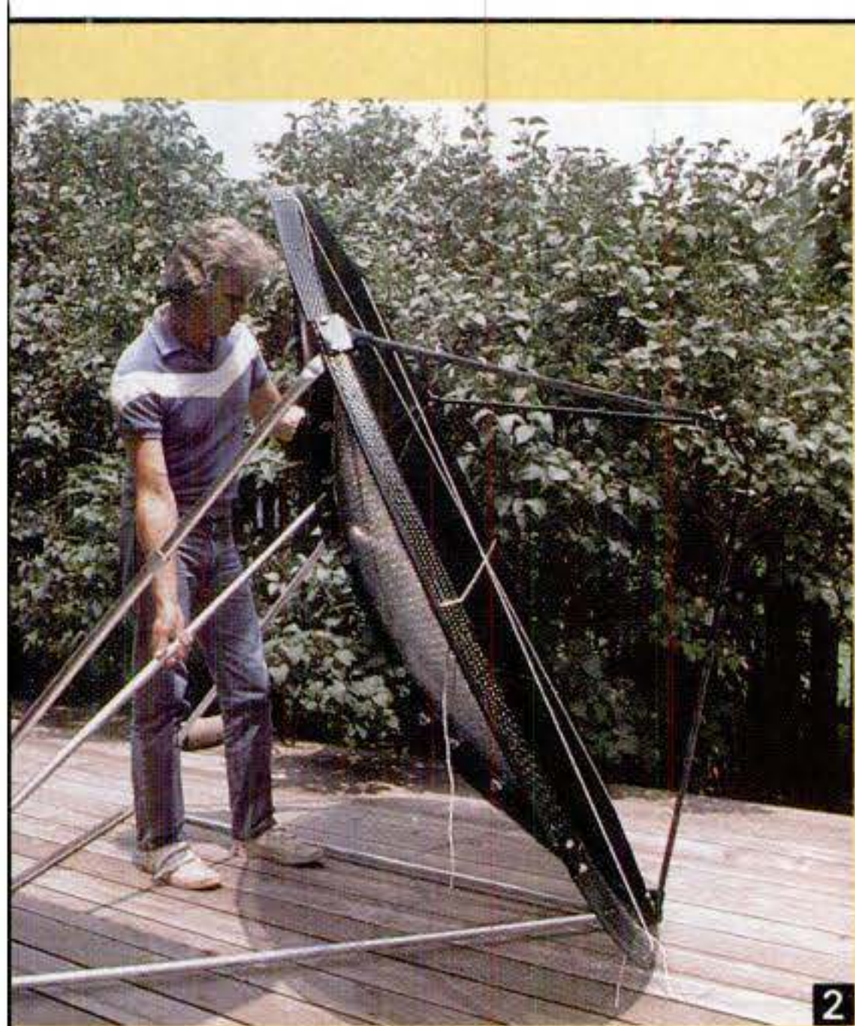



DRAWING BY MITCHELL J. ALBALA



2

4

PHOTOS BY DAVE HOUSER

## Unscrambling—how it works

**"To start the unscrambling process, you press a button on the descrambler's front panel," says Dr. Mark Medress, designer of the M/A-Com VideoCipher descrambler. "That produces a number—an authorization code—on the TV screen, which you give to the programmer." The programmer, such as HBO, adds your authorization code to the programming material, scrambles, and sends it to satellite for home reception (see drawing above). In your home, the picture and sound are descrambled separately. "A scrambled picture has its colors reversed," says Medress. "Black is white, and white is black. And there is no synchronization to mark the beginning of a single frame. The picture floats on the screen." Conventional cable-system descrambling circuits reverse the colors to normal and add a synchronization pulse to reestablish the picture. Descrambling the audio information, however, is much more difficult. "The audio is digitized and encrypted using the data encryption standard (DES) algorithm," explains Medress. The descrambler uses the DES algorithm—a formula—to electronically convert the scrambled audio back to normal. But the formula requires a special number—a key—to break the code. "The key is a 56-bit-long sequence, which makes the odds of someone guessing it about one in 72 quadrillion," says Medress. Even if you did get lucky, that key only exposes more raw data encrypted within more keys. The next levels of keys determine if your box is authorized, what programs you can receive, and if your box should be turned on this month. "If you don't pay your bill, the box turns off," says Medress. Because the audio is encoded in digital form, its quality can be as good as a compact disc. Other data, such as text pages of program listings and electronic movie rating for parental control, can be encoded also.—W. J. H.**

bidding. They fear cable operators may take them off the air if they don't cooperate. And most experts agree that all three networks will eventually scramble their feeds—national programs and advertisements sent to affiliate stations who add local news and ads before broadcasting to their areas. CBS has already announced its scrambling plans, and the network says it *won't* turn on descramblers to receive the signal. Diane Davis—and about 400,000 other Americans—won't be able to get *60 Minutes,* and she feels it's a violation of her rights. "We have just as much right to a [network TV] signal as we do to a telephone or electricity," she asserts. The networks disagree.

Phillip Jones, chairman of the CBS affiliates board and of KCTV in Kansas, says the local affiliates "should be able to rely on receiving an exclusive service." But no one knows whether dish owners who live within range of an affiliate station prefer to watch the national feeds on satellite.

Harold Crump, chairman of the NBC affiliates' legislative committee, says dish owners often intercept sports feeds intended for other locales. This interferes with the network's agreements with the sports industry, he claims. And it means that the network steals viewers from its own affiliates.

Though the network's scrambling plans may sound grim, the skies are a long way from dark. New channels are still going on the air: About a dozen are expected next year, so dish owners still have scores of channels to watch. They aren't hurrying to sign up for monthly fees. In fact, the four premium services had sold a total of only 60,000 subscriptions by early autumn.

There are many reasons why most

[Continued on page 94]



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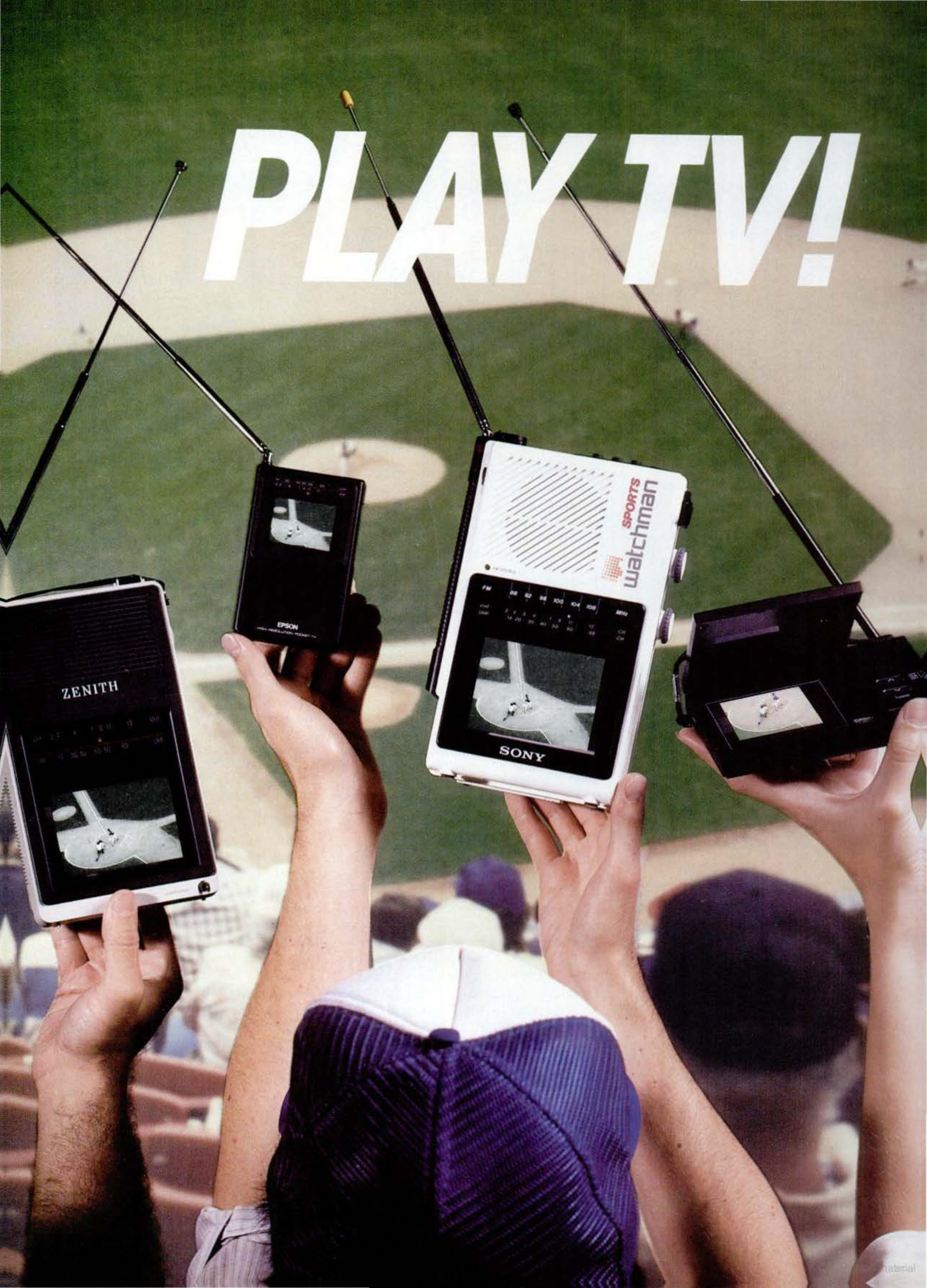
# PLAY TV!



# A new generation of tiny TV sets comes in a variety of sizes and prices and makes use of several novel display technologies.

**By NAOMI J. FREUNDLICH**
*Photo by John Neitzel*

It was a blustery, damp day at Camp David, and President Reagan and Japanese Prime Minister Yasuhiro Nakasone were touching off their long-planned trade talks with a traditional exchange of personal gifts. Prime Minister Nakasone was given a monogrammed Navy flight jacket and some autographed golf balls. In return he offered the President a truly Japanese gift, direct from the land of miniatures: the world's smallest television set. Long planning aside, the talks were delayed several minutes while Reagan switched on the TV to watch some fast-breaking dunking action of a Washington Bullets basketball game.

"Mini TV sets are popular with sports fans who can't bear to miss a game, or a replay at a live event," says John Witt, marketing vice president at Citizen Consumer Electronics. "The sets are also gaining popularity with soap-opera watchers, who keep them hidden in their office desk drawers."

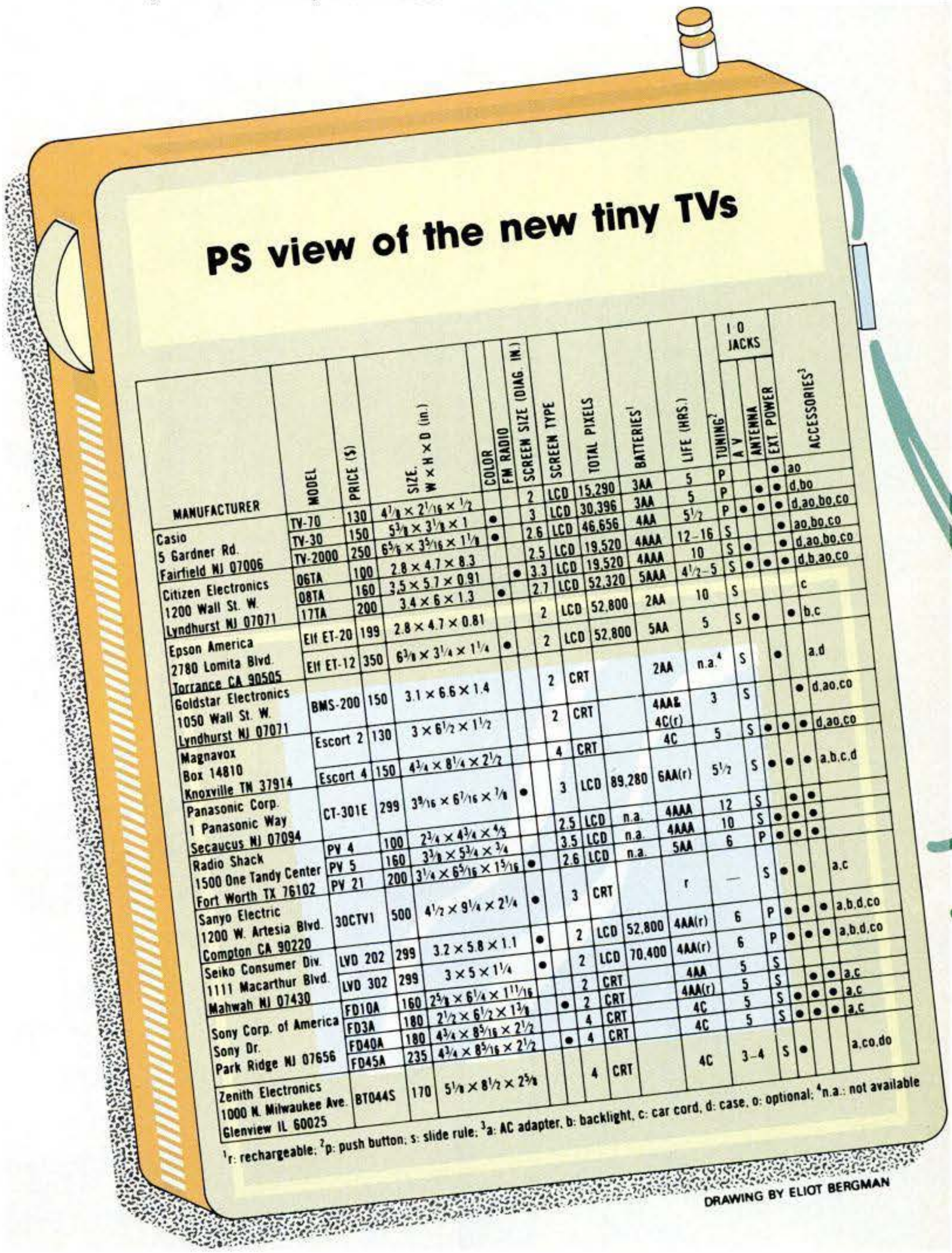
And with built-in extras like FM radios, clocks, water-resistant shells, sun shields and audio-visual jacks that turn the tiny TVs into mini video monitors, their popularity is spreading even more. But most importantly, to create a better picture, smaller and thinner size, and a less power-hungry set, small-screen TVs are beginning to use some of the technologies PS has been telling you about [PS, Nov. '85; July '85; Nov. '82].

Basically, two ways are now used to make TVs small: redesign the conventional cathode-ray tube (CRT) or use a liquid-crystal-display (LCD) screen. In Sanyo's new 2¼-inch-deep hand-held color TV, the clunky CRT has been scaled down to a flat three-inch version with the electron gun dropped below the phosphor screen, rather than behind and perpendicular to it. Instead of using three electron beams and a metallic shadow mask, Sanyo uses a digital technique called beam indexing to create a color image with only one electron beam [PS, Nov. '85]. "Had we used a standard picture tube, we would have come up with a set about six to seven inches deep," says Chuck Davis, sales promotion manager at Sanyo.

The smallest TVs—pocket-sized—use LCD screens. Epson, Seiko, and, this month, Panasonic have introduced tiny TVs that are the size of an audio cassette. They use an advanced LCD technology called active-matrix LCD. In these sets each pixel, or picture element, is driven directly by a thin-film transistor. "With the active matrix you can get varying shades of color, depending on how hard you drive the transistor," says Jerry Surprise, TV product manager for Panasonic. "This gives the display more precise color value." To step up resolution, the Panasonic Pocket Watch has almost 90,000 pixels. Its contrast ratio (the ratio of black to white) is 30:1, almost six times greater than earlier LCD sets.

LCD sets, unlike CRTs, work best when viewed outdoors or in lighted rooms because they create an image by reflecting light. Some, like Casio's models and the Citizen 06TA and 08TA, have pop-up screens that let natural light pass through, projecting the image onto a viewing mirror. Other models have built-in or optional backlights, which allow the sets to be viewed anywhere but tend to drain the batteries faster.

Although LCD advancements hold the most promise for building ultra-thin TVs and other displays, the CRT sets at this point still have better picture resolution. But with CRT sets you do give up compactness, and they use up batteries about twice as fast as LCD models. PS



**PS view of the new tiny TVs**

| MANUFACTURER | MODEL | PRICE ($) | SIZE, W × H × D (in.) | COLOR | FM RADIO | SCREEN SIZE (DIAG. IN.) | SCREEN TYPE | TOTAL PIXELS | BATTERIES[1] | LIFE (HRS.) | TUNING[2] | I/O JACKS: A/V | I/O JACKS: ANTENNA | I/O JACKS: EXT. POWER | ACCESSORIES[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Casio, 5 Gardner Rd., Fairfield NJ 07006 | TV-70 | 130 | 4 7/8 × 2 1/16 × 1/2 | | | 2 | LCD | 15,290 | 3AA | 5 | P | | | • | ao |
| | TV-30 | 150 | 5 3/8 × 3 1/8 × 1 | • | | 3 | LCD | 30,396 | 3AA | 5 | P | | • | • | d,bo |
| | TV-2000 | 250 | 6 5/8 × 3 5/16 × 1 1/8 | • | | 2.6 | LCD | 46,656 | 4AA | 5 1/2 | P | • | • | • | d,ao,bo,co |
| Citizen Electronics, 1200 Wall St. W., Lyndhurst NJ 07071 | 06TA | 100 | 2.8 × 4.7 × 8.3 | | | 2.5 | LCD | 19,520 | 4AAA | 12–16 | S | | | • | ao,bo,co |
| | 08TA | 160 | 3.5 × 5.7 × 0.91 | | • | 3.3 | LCD | 19,520 | 4AAA | 10 | S | • | | • | d,ao,bo,co |
| | 17TA | 200 | 3.4 × 6 × 1.3 | • | | 2.7 | LCD | 52,320 | 5AAA | 4 1/2–5 | S | • | • | • | d,b,ao,co |
| Epson America, 2780 Lomita Blvd., Torrance CA 90505 | Elf ET-20 | 199 | 2.8 × 4.7 × 0.81 | | | 2 | LCD | 52,800 | 2AA | 10 | S | | | | c |
| | Elf ET-12 | 350 | 6 3/8 × 3 1/4 × 1 1/4 | • | | 2 | LCD | 52,800 | 5AA | 5 | S | • | | • | b,c |
| Goldstar Electronics, 1050 Wall St. W., Lyndhurst NJ 07071 | BMS-200 | 150 | 3.1 × 6.6 × 1.4 | | | 2 | CRT | | 2AA | n.a.[4] | S | | • | | a,d |
| Magnavox, Box 14810, Knoxville TN 37914 | Escort 2 | 130 | 3 × 6 1/2 × 1 1/2 | | | 2 | CRT | | 4AA & 4C(r) | 3 | S | | | • | d,ao,co |
| | Escort 4 | 150 | 4 3/4 × 8 1/4 × 2 1/2 | | | 4 | CRT | | 4C | 5 | S | • | • | • | d,ao,co |
| Panasonic Corp., 1 Panasonic Way, Secaucus NJ 07094 | CT-301E | 299 | 3 9/16 × 6 7/16 × 7/8 | • | | 3 | LCD | 89,280 | 6AA(r) | 5 1/2 | S | • | • | • | a,b,c,d |
| Radio Shack, 1500 One Tandy Center, Fort Worth TX 76102 | PV 4 | 100 | 2 3/4 × 4 3/4 × 4/5 | | | 2.5 | LCD | n.a. | 4AAA | 12 | S | | • | • | |
| | PV 5 | 160 | 3 3/8 × 5 3/4 × 3/4 | | | 3.5 | LCD | n.a. | 4AAA | 10 | S | • | • | • | |
| | PV 21 | 200 | 3 1/4 × 6 5/16 × 1 5/16 | • | | 2.6 | LCD | n.a. | 5AA | 6 | P | • | • | • | |
| Sanyo Electric, 1200 W. Artesia Blvd., Compton CA 90220 | 30CTV1 | 500 | 4 1/2 × 9 1/4 × 2 1/4 | • | | 3 | CRT | | r | — | S | • | • | | a,c |
| Seiko Consumer Div., 1111 Macarthur Blvd., Mahwah NJ 07430 | LVD 202 | 299 | 3.2 × 5.8 × 1.1 | • | | 2 | LCD | 52,800 | 4AA(r) | 6 | P | • | • | • | a,b,d,co |
| | LVD 302 | 299 | 3 × 5 × 1 1/4 | • | | 2 | LCD | 70,400 | 4AA(r) | 6 | P | • | • | • | a,b,d,co |
| Sony Corp. of America, Sony Dr., Park Ridge NJ 07656 | FD10A | 160 | 2 5/8 × 6 1/4 × 1 11/16 | | | 2 | CRT | | 4AA | 5 | S | | | | |
| | FD3A | 180 | 2 1/2 × 6 1/2 × 1 3/8 | | • | 2 | CRT | | 4AA(r) | 5 | S | | • | • | a,c |
| | FD40A | 180 | 4 3/4 × 8 5/16 × 2 1/2 | | | 4 | CRT | | 4C | 5 | S | | • | • | a,c |
| | FD45A | 235 | 4 3/4 × 8 5/16 × 2 1/2 | | • | 4 | CRT | | 4C | 5 | S | • | • | • | a,c |
| Zenith Electronics, 1000 N. Milwaukee Ave., Glenview IL 60025 | BT044S | 170 | 5 1/8 × 8 1/2 × 2 5/8 | | | 4 | CRT | | 4C | 3–4 | S | • | | | a,co,do |

[1]r: rechargeable; [2]p: push button; s: slide rule; [3]a: AC adapter, b: backlight, c: car cord, d: case, o: optional; [4]n.a.: not available

DRAWING BY ELIOT BERGMAN

**Take them to the ball game! Tiny TVs, from left: Zenith BT044S, Epson Elf, Sony Watchman, and Casio TV-2000.**
SIMULATED TV PICTURES



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# CD for the road

Buckle up, and ready your ears—compact discs have hit the road. New models offer the same high-quality audio as home machines, but these are made for an instrument panel.

**By GORDON McCOMB**

"Fasten your seatbelt," he ordered. I snapped the belt in place and cinched it around my waist. "Ready?" he asked, looking to me for a signal. I pushed the compact disc into the instrument-panel-mounted player and pressed the "Play" button. Full, rich, undistorted sound filled the automobile. But for how long? "Go," I yelled, and long-time friend Matt Pechstein released the clutch in his '66 Mustang. We were off.

CD makers claim that the newest generation of players—those made for cars and vans—are engineered to withstand the jolts and jumps of everyday driving, yet still provide the crystal-clear sound that has become the trademark of digital audio. So for the next hour we hit America's streets, seeking the most treacherous potholes, speed bumps, and dips we could find.

Our most severe test: "Railroad tracks dead ahead," announced Pechstein, a sheepish grin covering his face. We took the tracks at 30 mph. Our bodies sprang up like rubber balls; the music on the CD player went on without interruption.

We backtracked and went over the tracks again, this time at 40. The bump was even more jarring than before, and my head scraped against the roof of the car. I listened carefully, and was amazed. The player didn't miss a beat. And more important (especially to people who avoid such in-the-field tests), the sound is superb, unmatched by even the best cassette-based automotive stereo systems. I also found that the CD player isn't prone to wow and flutter, common ailments of cassette decks. And tape copies of the disc sounded muddy by comparision.

I was sold. My findings: CD players for the car really do work, and work so well that they're now available from a variety of audio makers (see table). Even auto makers like Mazda, Mercedes-Benz, and Ford offer them in their deluxe-model cars.

Now for the bad news. New designs make CD players expensive—up to three times the price of a good cassette deck. That makes them more prone to theft. And I discovered that CDs are a bit more difficult to install than cassette units. What's more, unless your existing car stereo system is a good one, you'll need new speakers and possibly some expensive extras. Here's the whole story.

## On track

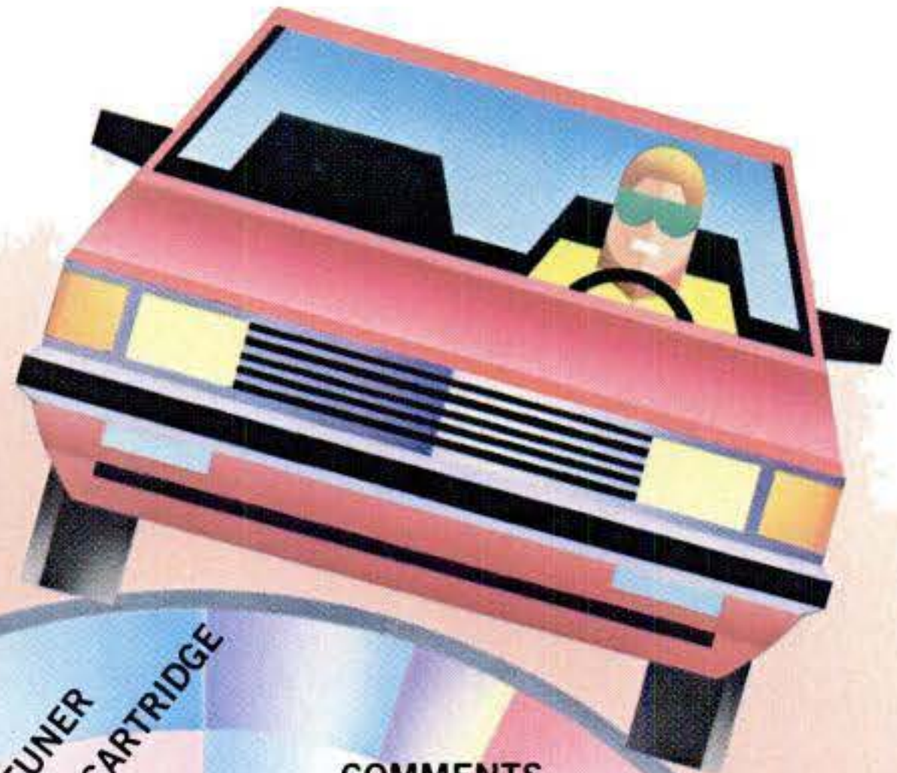
CD players for the car work the same way as home players. They use a laser light to read a digitally encoded soundtrack off the bottom surface of a disc. The laser light is kept focused on the spiral track by a precision optical servomechanism and computerized circuitry. If the laser veers to either side of the track, the servo corrects the position to keep the light on target. In most CD players, two small spot beams located on either side of the main beam are used to detect when the laser strays.

These three-beam servo systems do an excellent job of keeping the laser on the spiral, but even a gentle shock could yank the laser off course. That can't be tolerated in a car unit, so auto CDs have a sophisticated damping mechanism to protect the laser and other optical components of the player against shock.

"Car CD players use an improved anti-shock mounting system that physically isolates the laser optical system from the outside world," says Gary S. Weissberg, director of product development at Sanyo Electric. The mounting system works like a soft foam cushion, absorbing road shock and bumps. Also, the size of the playback system—laser, lenses, and tracking motor—has been reduced. "The smaller the mass of the optical system, the less susceptible it is to shock," adds Weissberg. "It took two years to develop the system in our FETC-1 and FETC-2 car CD players. It is much smaller than the servomechanism in our home decks. A good car CD can now withstand shock better than most cassette decks."

Engineers at Sony Corp. of America reduced the size of the optics in the CDX-5, CDX-R7, and DiscJockey CD players by adding a new folded optics system, a technique commonly used in expensive pocket binocu-

*Continued*



**PS buyer's guide to selected car CD players**

| BRAND | MODEL | PRICE ($) | TUNER | CARTRIDGE | COMMENTS |
|---|---|---|---|---|---|
| Alpine | 5900 | 600 | | | Audible feedback controls |
| | 7900 | 800 | • | | Same as 5900; with tuner |
| Audiovox | HCD-100 | 700 | | • | |
| Blaupunkt | CDP 05 | 550 | | • | |
| Denon | DCC-8900 | 899 | • | | Anti-theft slide tray |
| Fujitsu Ten | SD-1110 | 550 | | | Digital filtering |
| Hitachi | CD-D4 | 599 | | | Auto replay if track skips |
| Kenwood | DKC-9 | 659 | | | Electronic volume control |
| Mitsubishi | CD-100, 1 | 699 | | | With 25 watt/ch. amp |
| | CD-100, 2 | 999 | • | | Same as above; with AM-FM cass. deck |
| Panasonic | CQ-E800D | 700 | • | | Single-beam laser |
| Philips | CD-10 | 399 | | | Portable; digital filtering |
| | DC0-85 | 549 | | | Digital filtering; audio compression |
| Pioneer | CDX-1 | 549 | | | 10-sec. intro-scan; for Pioneer Centrate system |
| | CDX-P1 | 599 | | | 10-sec. intro-scan |
| Sansui | CD-X500 | 599 | | | 16-track programming |
| Sanyo | FETC-1 | 549 | • | | Viper security system |
| | FETC-2 | 649 | • | | Viper security system; skip fwd., back |
| Sony | CDX-5 | 600 | | | RCA jacks for amp connection |
| | CDX-R7 | 700 | • | | RCA jacks for amp connection |
| | DiscJockey | 999 | | • | 10-disc changer; trunk mounted; tuner $129 |
| Technics | CQ-DP5 | 700 | | | Single-beam laser |
| Yamaha | YCD-1000 | 549 | | • | Digital filtering |

Prices are manufacturers suggested retail; all units use analog filters unless otherwise specified

DRAWING BY NICHOLAS GAETANO



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lars. "The light still travels the same distance as it did with earlier CD models," explains Marc Finer, Sony's product communications manager, "but in a smaller space, because it's bounced off a series of miniature mirrors. The laser system in our car units is two-thirds the size of those in our home models."

Although the improved mounting system and reduced size of the optical pickup don't guarantee 100-percent skip-free operation, the problem seems to be beaten. Another problem that hasn't, however, is heat.

"Roll up the windows on a hot day, and your car quickly becomes a moving oven," says Alex Lovey, an auto stereo installer in the San Francisco area. "Temperatures exceeding 120 degrees aren't uncommon, especially during summer. Try to work a car CD player in even 100-degree heat, and it'll stop dead on you."

Why? "Semiconductor lasers are temperature-sensitive devices," says Sanyo's Weissberg. "Even the smallest variation in temperature affects its output. We use circuitry that constantly senses the light level of the laser and compensates for any variance." But the compensation works only so long. As the heat rises, the more unstable the laser becomes—until it can't provide a steady stream of light to adequately read the disc.

### Tight fit

Despite the shrinking size of the optical assembly and other components, the mechanism of a CD player is large. There isn't enough space to pack the optical system, motors, logic circuitry, microprocessor, pre-amplifier, and other components of the typical car CD in one box that fits in the instrument panel. Result: CD systems come in two or three boxes.

"The extra components make installation a bit tougher than with a cassette deck," says Lovey. The added boxes must be secured under the instrument panel or against the kick panel or fire wall. A color-coded wiring harness connects the pieces together.

These components are in addition to any amplifier or power booster required to complete the system. CD players don't come with their own amplifiers. If you don't have a stereo system in your car, you'll need to add speakers and either an outboard amplifier or an equalizer/power booster to the CD player. Amplifiers and equalizer/boosters do much the same job, but the equalizer/booster lets you tailor the sound to better match the acoustics in your car. Most boosters don't deliver more than 15 or 20 watts per channel, however, so if you want eardrum-shattering sound with a minimum of distortion, buy a high-wattage component amplifier.

If you already have a cassette deck in your car, you may be able to use its amplifier to run the CD. For ease of installation, the deck should have auxiliary inputs to accept the signals from the CD player. Some decks are labeled as "CD ready," which means it has the proper input jacks.

If your cassette player isn't so equipped, you'll need an adapter to make things work. A $20 Recoton CD adapter attaches the CD to a cassette with a single cable. The cassette end looks like a tape, and inserts into the tape mechanism. Parasound, Jensen, and Sparkomatic have adapters that do a similar function.

A number of CD players are designed to use specific cassettes or amplifiers, making installation with non-compatible gear a headache. For example, I couldn't install a Mitsubishi CD-100 in my car because power for the player is controlled through the company's RX-741 or CV-231 dash units. My cassette deck lacked comparable inputs, and the manual for the CD-100 didn't have a wiring diagram to show me how to make it work with my system. The lesson I learned: If the player you like requires specific equipment, make sure you have it before you attempt installation.

> *"A good car CD player can now withstand shock better than most cassette decks"*

### Easy touch

A number of car CDs are player-only; others come with a built-in stereo AM-FM tuner. Apart from that, most share the same basic features, including three-spot laser beam, bass and treble controls, automatic power disc eject, programmability, and music search. And they all have essentially the same specifications: 20- to 20,000-Hz frequency response, 90-db signal-to-noise ratio; and 90-db or better dynamic range. The real difference I discovered, is not what you hear, it's what you *feel*.

For instance, models such as the Alpine 5900 and Sanyo FETC-1 have positive controls that are easy to work—especially sight unseen at 55 mph. Some of the players even have audible feedback controls: The 5900 beeped whenever I pushed a button. Before buying a car CD, try its controls. Avoid models you think would be hard to work when cruising down the highway.

An aggravating trait of many of the players I tried was the method of disc ejection. Push the eject button on models like the Pioneer CDX-1 and Mitsubishi CD-100, and a motorized mechanism inside the player pops the disc out the front. The problem: The disc comes out less than ½ inch, making it impossible to grab without getting finger smudges on it. Although CDs are supposed to play well even when lightly scratched, I like to keep my discs as clean as possible.

A few players, including the Yamaha YCD-1000 and Blaupunkt CDP 05, are designed with a cartridge-loading mechanism. Each disc is kept in a plastic cartridge that you load into the player. The cartridge protects the disc and makes loading easier, but because you must buy a cartridge for each disc, it's an added expense.

A more elaborate approach is found in the Sony DiscJockey. "The DiscJockey mounts in the trunk of your car," says Sony's Finer. "The unit has a built-in disc changer, which can hold up to ten discs." From inside the car, you select any song—on any of the 10 discs—by tapping a button on a wired remote control.

Do compact discs sound as good in the car as they do in your living room? No. "Even with good speakers, car acoustics leave a lot to be desired," says installer Lovey. "High frequencies are absorbed, low frequencies bounce around the small enclosure, and low-level audio is masked by road and engine noise."

But they are better than any auto system of the past, and all that seemed insignificant in Pechstein's car as we continued our road test. Clear, crisp sound filled our ears. Clear, crisp, summer air filled our nostrils.

"Look," said Pechstein, "a drawbridge!"

"So?" I asked.

Pechstein looked like a matador sizing up a bull. "Hang on," he said. "It's open." PS

**CAR CD PLAYERS: SELECTED MANUFACTURERS**

**Alpine Electronics of America,** 19145 Gramercy Pl., Torrance CA 90501; **Audiovox Corp.,** 150 Marcus Blvd., Hauppauge NY 11788; **Blaupunkt,** 2800 S. 25th Ave., Broadview IL 60153; **Denon America,** 27 Law Dr., Fairfield NJ 07006; **Fujitsu Ten Corp. of America,** 19281 Pacific Gateway Dr., Torrance CA 90502; **Hitachi Sales Corp. of America,** 401 W. Artesia Blvd., Compton CA 90220; **Mitsubishi Electric Sales America,** 3030 E. Victoria, Rancho Dominguez CA 90221; **Panasonic Co.,** 1 Panasonic Way, Secaucus NJ 07094; **Philips Auto Audio/Amperex,** 230 Duffy Ave., Hicksville NY 11801; **Pioneer Electronics (USA),** 5000 Airport Plaza Dr., Long Beach CA 90815; **Sansui Electronics Corp.,** 1250 Valley Brook Ave., Lyndhurst NJ 07071; **Sanyo Electric (Consumer Electronics Div.),** 1200 W. Artesia Blvd., Compton CA 90220; **Sony Corp. of America (Sony Consumer Products Co.),** Sony Dr., Park Ridge NJ 07656; **Technics,** 1 Panasonic Way, Secaucus NJ 07094; **Yamaha Electronics Corp., USA,** 6660 Orangethorpe Ave., Buena Park CA 90620



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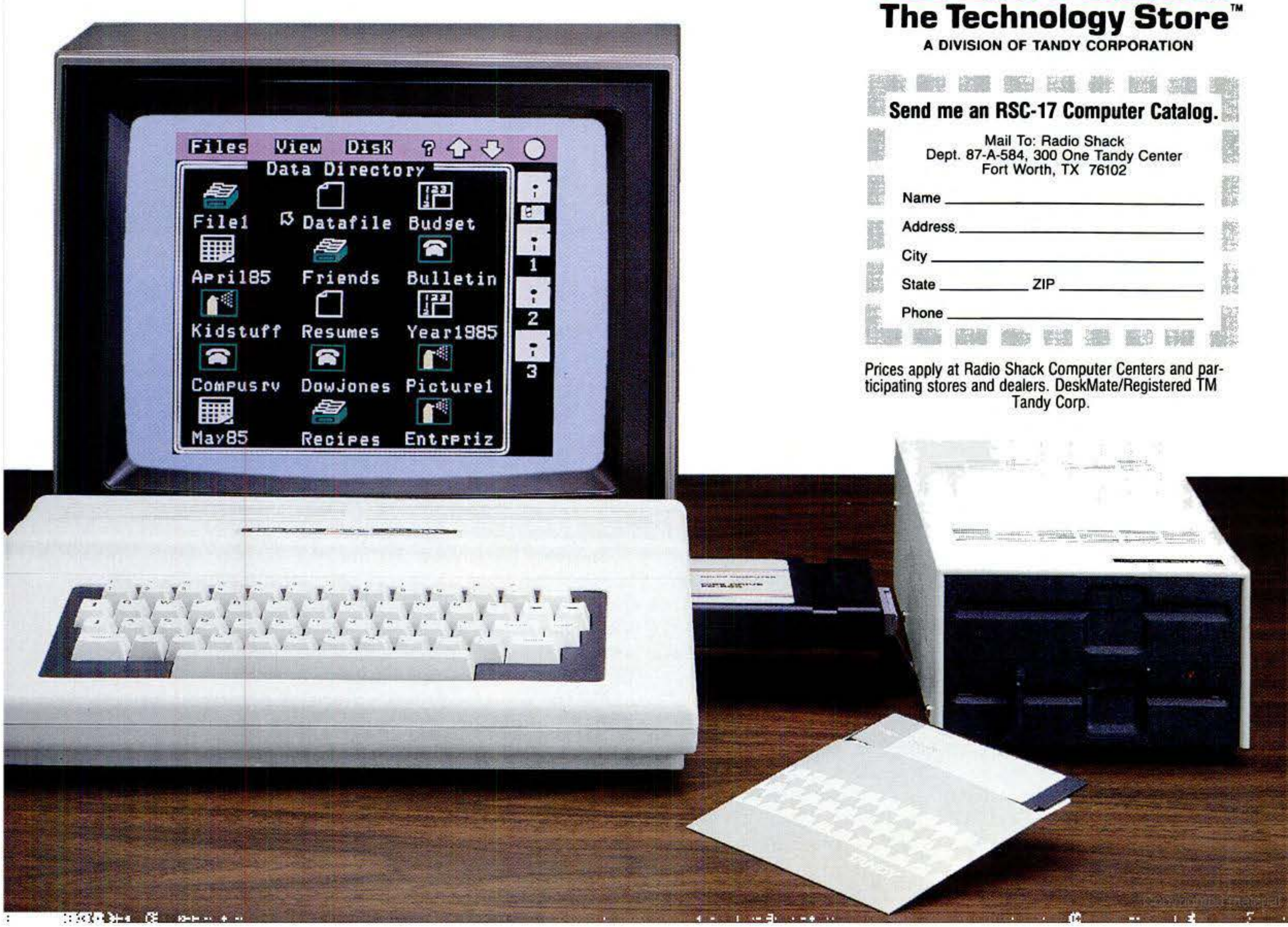

# Big-bass TV

PHOTO BY MIKE KELLY

A 4.5-inch speaker is mounted in a 6.6-foot-long pipe that's bent to fit inside a digital TV. Sound strange? No. The big bass from a small TV sounds terrific.

**By WILLIAM J. HAWKINS**

CHICAGO, ILL.

The three-foot-square speakers on either side of the stage thunder with sound. No surprises—they're certainly big enough to reproduce the deep bass music I hear. But two men approach from the shadowy aisles of the darkened auditorium. Each man steps on the stage and stands behind a speaker. Then, slowly, they begin lifting. These aren't speakers at all. They're dummy enclosures, and underneath each one is a Zenith table-model TV. All that sound is coming from tiny speakers inside a TV. How is it possible?

"I'm going to show you something," says a smiling Dr. Amar Bose, chairman of Bose Corp., as he walks onto the stage. He hefts what appears to be a sewer pipe, and stands it on end so its 80-inch length just crests the top of his head. "This is a waveguide," he says. "Sound pressure from a speaker placed near one end is amplified to enormous pressure at the other. It works like a pipe in a pipe organ." But unlike an organ pipe, the waveguide, first shown about a year ago [PS, April '85], doesn't amplify just one frequency. "We discovered that if the speaker is placed exactly one-third of the way inside the pipe, a range of frequencies is amplified," Bose explains.

Because the waveguide amplifies air pressure, a 4.5-inch speaker can move the large volume of air needed to reproduce low (below 400 Hz) frequencies. To get it into a TV set, the waveguide is bent, so sound travels through an acoustical maze inside a boxlike container and escapes through two holes in the rear of the cabinet. (Above, Bose holds the waveguide box.) Stereo separation and mid- to high-frequency audio comes from two front-mounted speakers.

Although I found that the short distance between the speakers limits stereo separation, the overall sound is remarkable. The Bose system will be used in four new 27-inch Zenith digital-TV models. Prices: $1,400 to $1,700. PS



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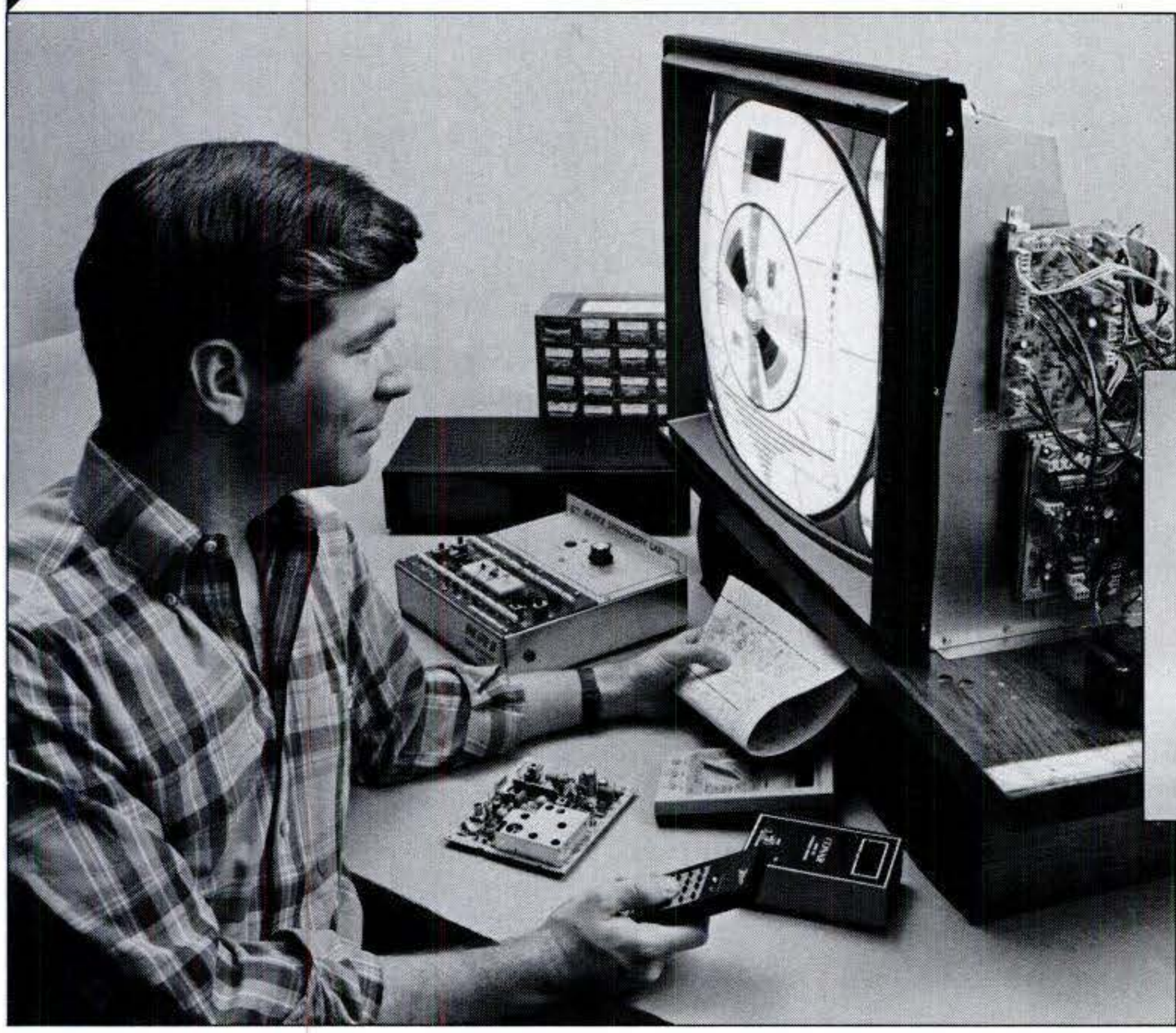

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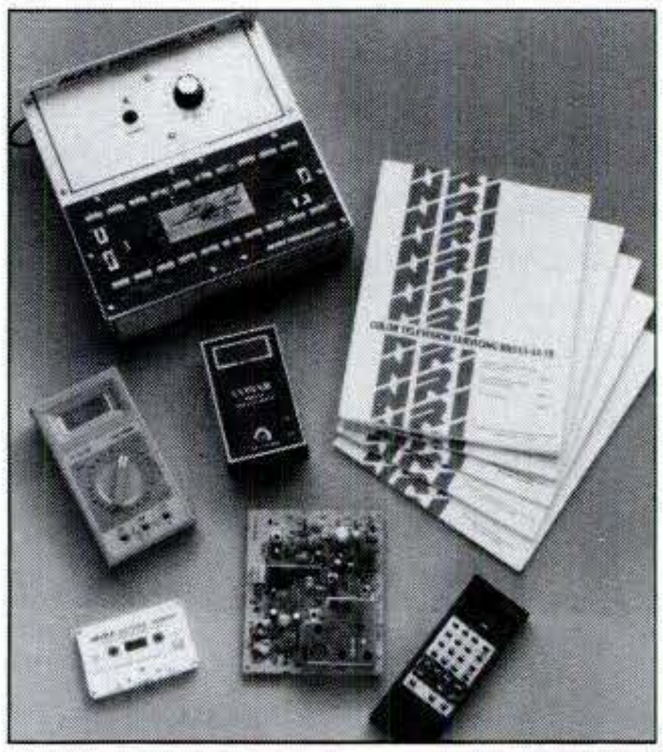

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## Master remote

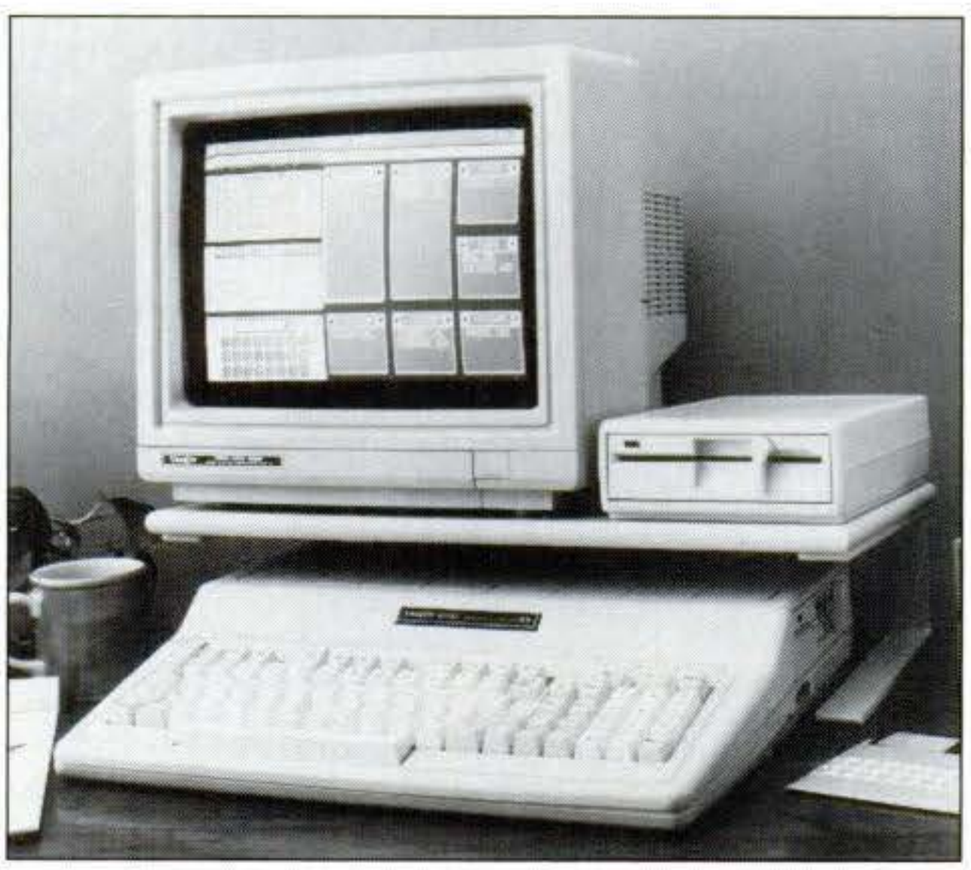
Do you ever grab the remote for your TV and try to switch on the VCR? Multiple remote controls can be confusing, so the majority of this year's Magnavox, Philco, and Sylvania remote-control TVs are equipped with a master unit (above right). The unit is available in a 33-button TV-VCR-cable or a 24-button TV-VCR version. Either can be used with any of 29 VCRs and 15 cable box systems. NAP Consumer Electronics Corp., Box 14810, Knoxville, Tenn. 37914.

Control Central 3 (above left) is a similar device, but it is sold alone and it can be programmed to control most brands of TVs, VCRs, compact-disc players, cable boxes, or stereo amplifiers. Made by General Electric Co. (Portsmouth, Va. 23705), the $100 unit is programmed by placing it in front of the original remote-control device and pushing a button.

## Home computers

A mouse-driven computer for under $250? Yes. The Commodore 64C (top), a refined version of the C64, uses the Graphics Environment Operating System (GEOS). The software allows point-and-click commands found on more expensive machines. Also included: QuantumLink software, a telecommunications network for access to on-line news, encyclopedias, and games. For C64 users, GEOS alone is $60. Commodore, 1200 Wilson Dr., West Chester, Pa. 19380.

The Tandy 1000 EX (bottom), an IBM-compatible computer, comes with graphics-oriented software called Personal DeskMate, 256K of memory, and a 5.25-in. disk drive for $799. It's 50% faster than the IBM PC, says Tandy (1800 One Tandy Center, Fort Worth, Texas 76102).



## Crucial calculator

It's the size of a credit card, and it works like a mini-calculator. But the Casio DC-700 also alphabetically stores important and confidential information. The new eight-digit calculator can store up to 20 items, including names and telephone, credit-card, banking, and passport numbers. Each item can contain up to 12 digits as well as six letters for labeling. Information is protected by requiring the user to enter a six-character password to access, delete, or alter the stored data. The DC-700 weighs 1.7 oz. and sells for $15. It's made by Casio, Inc. (15 Gardner Rd., Fairfield, N.J. 07006).



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## Hand-held copier

On-the-spot copying is easy with the Copy-Jack, a hand-held unit that copies text onto a 33-ft. roll of 1.6-in.-wide paper. To use Copy-Jack, place its window over the text to be copied. Then move the copier across the page at a rate of about 1 in./sec. The small copier is best for duplicating columns of numbers. To copy text wider than 1.6 in., you must make several vertical runs and tape the copies together. The copier uses a charge-coupled device to transfer the printed image onto heat-sensitive paper. Copy-Jack is 2.8 by 6.7 by 1.8 in. and costs $350. It's made by Plus USA Corp., 10 Reuten Dr., Closter, N.J. 07624.

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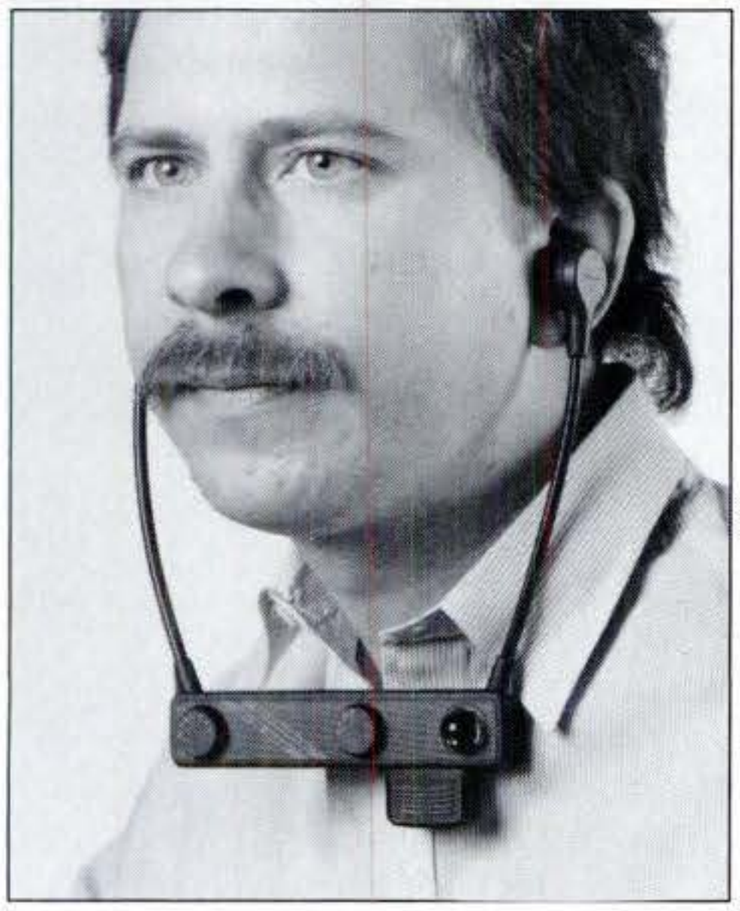
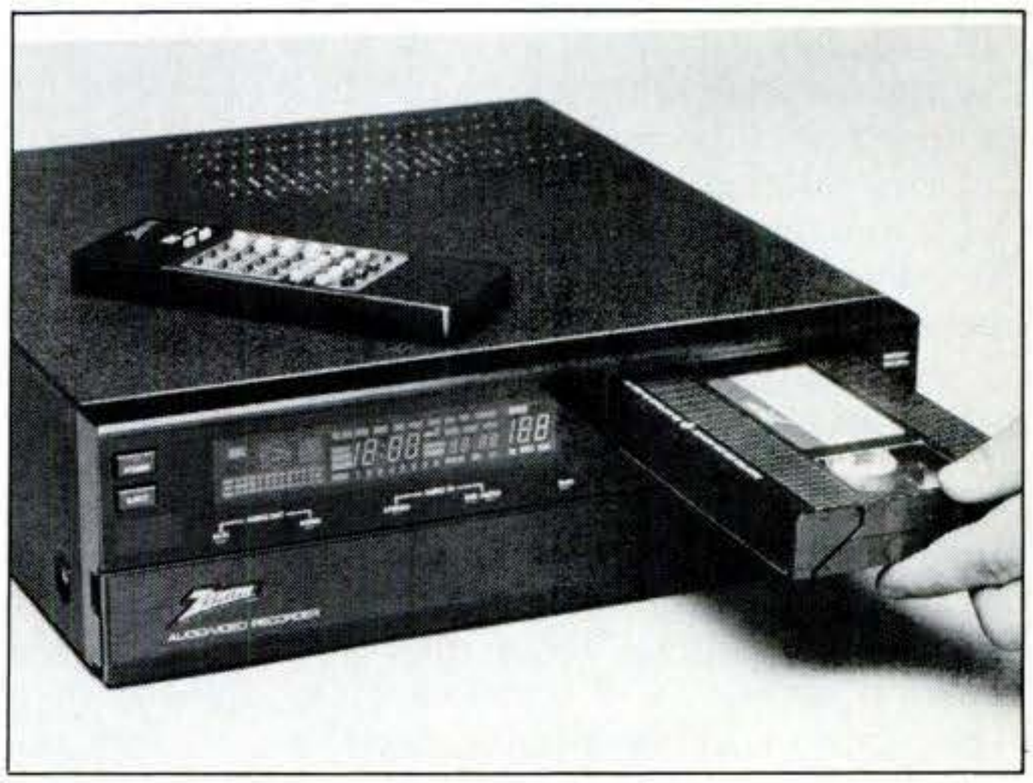
## Wireless headphones



You can't listen to your heartbeat with these wireless stethoscope-style headphones, but you can enjoy noise-free music. Sennheiser (48 W. 38th St., New York, N.Y. 10018-6297) uses a noise-reduction circuit in its infrared headphone system. A transmitter (not shown) connects to your hi-fi and sends the audio via IR light to the headset. The HDI/SI 234 is $480.

## Midi class



Conventional VCRs look bloated beside some of the new compact audio and video components, says Zenith. So the company is correcting the mismatch with two "midi" VCRs 25% narrower than standard decks.

The width of the decks was cut to under 13½ in. by rotating the front-loading mechanism 90°. "We approached the new design sideways—literally," says Gerald McCarthy, president of Zenith's sales division.

Compared with older VCRs, the mid-sized decks are a better match for audio equipment in performance, too. They will receive, record, and play back stereo-TV broadcasts. And when they are used as audio recorders, their new scanning feature automatically finds specific musical selections for you; the deck looks for an electronic signal that is automatically inserted on tape each time you begin recording. "With more audio enthusiasts using their VHS Hi-Fi VCRs for audio recording, we wanted decks that in size and in features would perform in video *and* audio systems," explains McCarthy.

Other features are similar to the ones found in full-size VCRs. Both the VR2300 ($900) and VR3300 ($1,000, shown above) have six heads, 178-channel quartz-electronic tuning, built-in multichannel sound decoding, and direct-input remote programming. Zenith Electronics Corp., 1000 Milwaukee Ave., Glenview, Ill. 60025.



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# Double-duty word machine

Amstrad, a European computer maker, now has a home word processor for the U.S. that's intended to replace your typewriter. How does it differ from Magnavox's Videowriter and Smith Corona's PWP? For one thing, the Amstrad machine is a computer, too.

**By WILLIAM J. HAWKINS**
*Photos by Greg Sharko*

Beep. The machine signals me that it is ready. Its green screen fills with the names of documents, and highlighted areas of the display show me what keys to press to get started. I'm using one the newest devices designed to replace your home typewriter. It's the Amstrad home word processor.

Designed in Europe, the Amstrad PCW8256 will compete here with Magnavox's Videowriter and Smith Corona's PWP [PS, May]. Like its competitors, the $799 Amstrad machine comes with a printer and is made for people who want to work with words—not computers.

But it differs from competitors, too. "It's a double-duty machine," said Otto Georgi, manager of the consumer electronics group for Sears World Trade, the U.S. distributors for the PCW. "Besides word processing, the PCW works as a computer, too." BASIC is included, and other software, such as SuperCalc II, a typing tutor, and a checkbook balancer, is available. But the PCW's strength is its word-processing ability. Its keyboard, screen, and printer are designed to work with LocaScript, the PCW's word-processing software.

LocaScript comes on a disk and starts when the PCW is switched on. The names of documents stored on the disk are automatically alphabetized and placed in separate menu groups. One group could consist of all manuscripts you've written, for instance, while others might be memos, reports, or letters. Each group also contains a template file, which tells LocaScript how the document should look. A template for the letters group could contain the margin settings, page width and length, and your name and address in a heading. When you start a new letter, LocaScript uses the file to set up the page for you.

To begin work, you use cursor-control keys to choose the document's name, and press "enter." In moments, the words in the document are displayed in up to 90 columns and 27 lines on the 12-inch screen.

To edit your work there are special keys, such as "cut," "copy," and "paste," that let you delete, copy, or move sections of text. The "cut" and "paste" keys are especially useful. You use "cut" and the cursor keys to mark the beginning and end of a block of text. Then you assign the block a number or letter (0–9 or A–Z), and the text disappears. You can retrieve the text later for insertion anywhere in the document by pressing "paste" and specifying its assignment character. That's helpful for moving a block of

*Continued*

**Top rear connector is for printer; bottom accepts serial interface box ($50) for a modem or letter-quality printer.**



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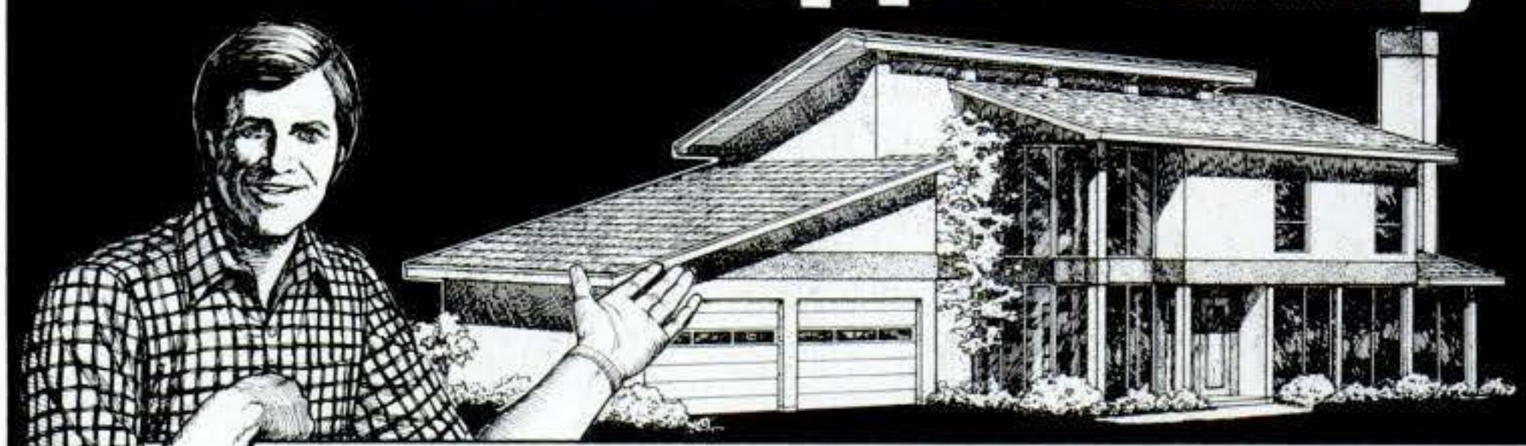
# A Golden Opportunity



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## Word machine

*Continued*

text, of course, but the "paste" key can be used in other ways, too. I assigned a block containing my business address to 1, a standard opening paragraph ("It was nice to see you . . . ") to 2, an ending paragraph ("Hope to hear from you soon . . . ") to 3, and saved them all on a disk. Now when I want to write a business letter, I start by pressing the "paste" key along with assignment characters. Creating a new letter is as easy—literally—as one, two, three.

Through all of this and other work—such as underlining words (underlines show on the screen), changing print (10, 12, 15, 17, or proportional spacing), and creating boldface, italic, and double-size character fonts—pop-up menus appear and disappear to keep up with you. The menus were helpful at first, but became time-consuming after I knew how to use the word processor.

"Once you're proficient with LocaScript, press the 'plus' key," Georgi told me. I did. After about three seconds a single large menu appeared. It included all the small menu items, and I could choose one quickly by typing its first few letters. For instance, I pressed "plus" and the letters RJ—the text shifted over and became right justified on the screen. There was no need to go through all the separate smaller menus designed for the novice. Also, if you type your request before the three seconds are up, even the large menu display is skipped.

When you've finished your work, the document can be saved temporarily in memory or permanently on the PCW's three-inch disk drive. Each side of a dual-sided disk holds about 70 pages of text (180 kilobytes).

The PCW's dot-matrix printer produces draft-quality copy at 90 characters per second (cps), correspondence quality at 20 cps. "But speed is insignificant on the PCW," said Georgi. Why? While one document is being printed, you can work on another.

If you're looking for a *computer* that does word processing, I don't think the PCW is for you. Its nonstandard three-inch disk drive and older operating system (CP/M Plus) will likely mean a limited supply of software. But as a word processor, the Amstrad PCW is a strong contender against the Smith Corona PWP and Magnavox Videowriter. LocaScript's ease of use and large screen make it a powerful system for both the home and office.

According to Georgi, the Amstrad PCW will be sold through major retail stores (including selected Sears stores), business-equipment dealers, and specialty electronics shops. PS



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# The everything card

**By G. BERTON LATAMORE**
*Photo by Burt Plotkin*

"This is a prototype," says SmartCard International president Arlen Richard Lessin, obviously pleased at the plastic card he hands me. "The final version will be no thicker than a regular credit card and will fit into a bank automated teller machine."

I'm sitting in the office of SmartCard International in New York, holding the world's smallest computer in one hand. It's the size of a credit card but twice as thick. It has a two-line LCD screen, a tiny battery for power, and a 10-key alphanumeric keyboard that resembles those on push-button telephones. This is Ulticard, a rigid piece of plastic that could be the first in a new generation of supersmart cards that help you in a variety of ways—from losing weight to saving your life (see caption). Also, it may be your next Visa card.

Ulticard was developed from the French smart card [PS, July '83], and was created in a short six months after Visa and SmartCard International announced plans for it.

"Ulticard is the first self-contained credit authorization system," says Lessin.

DRAWINGS BY ROY DOTY

**Future smart cards may act as a calculator or address book, and could**

- **Allow access to restricted areas by storing a digital version of fingerprints for comparison with real ones.**
- **Help you watch your weight by storing your caloric intake for the day.**
- **Hold prepaid tokens for phone calls, parking meters, and gas pumps.**
- **Store health and emergency data.**



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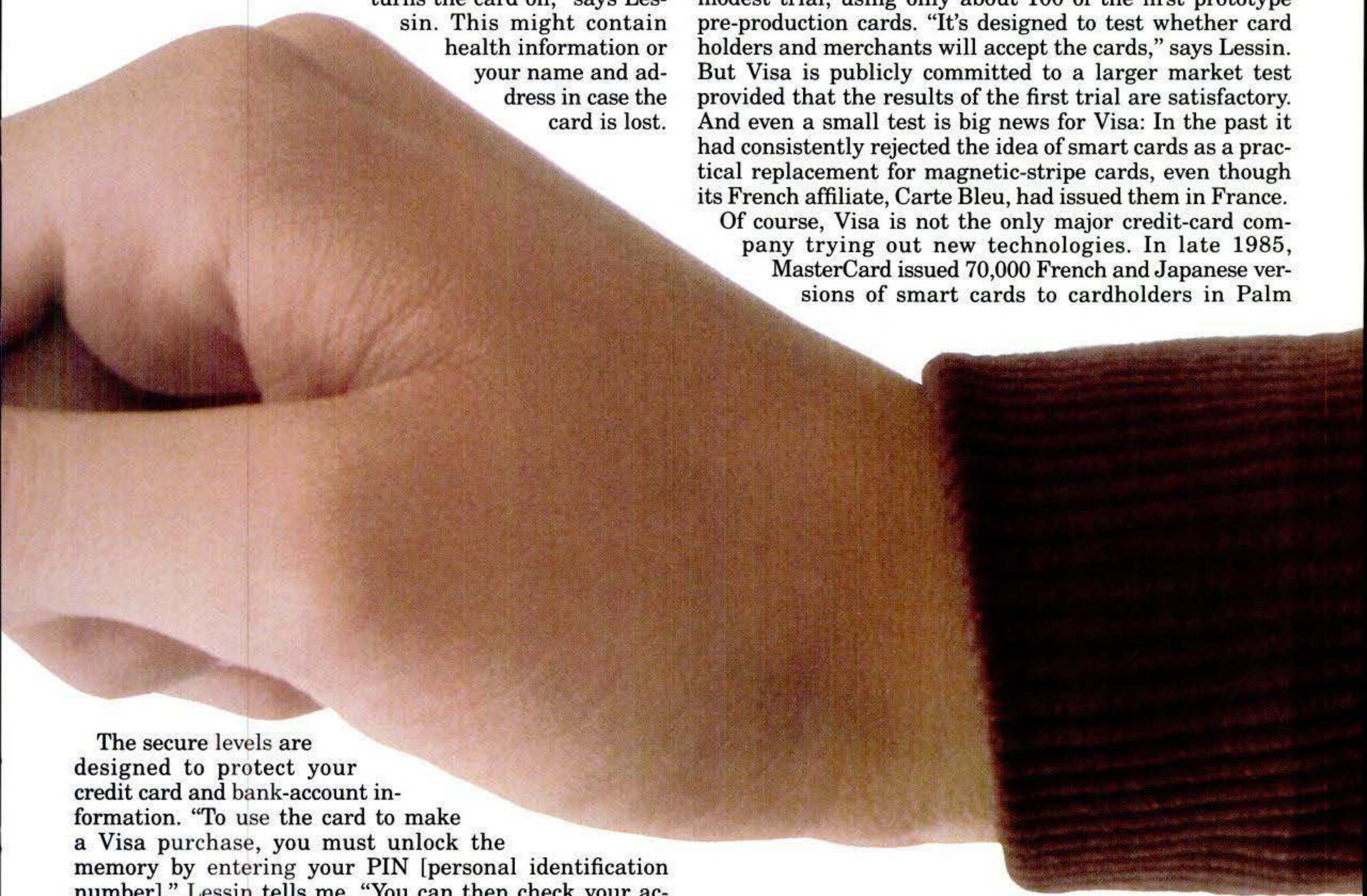
Master more possibilities with Ulticard, says Visa. It's a credit card—and a computer that stores credit records, checking accounts, addresses, and even health-care information.

"Even more, it's an automated wallet with a pocket reminder thrown in." Ulticard can hold the complete records of at least two accounts—either credit accounts such as Visa and MasterCard or debit accounts like an electronic checkbook. Also, it can store addresses, appointments, or even life-saving health data. And the final version, which Visa will ultimately call Super Card, will have a currency-conversion program and contain a magnetic stripe so it can act as any normal charge card.

Like the traditional smart card, Ulticard's memory is divided into three sections, each with a different security level. "The first level is open, accessible to anyone who turns the card on," says Lessin. This might contain health information or your name and address in case the card is lost.



The secure levels are designed to protect your credit card and bank-account information. "To use the card to make a Visa purchase, you must unlock the memory by entering your PIN [personal identification number]," Lessin tells me. "You can then check your account balance to make sure you have enough to make the purchase." You need not show your balance to the clerk, however. Once you've activated the card, you enter the amount of the purchase. "The card records it, deducts it from the balance, and displays an authorization code, which the clerk copies onto the charge slip," Lessin explains.

Your checking account would work similarly, except it would be a debit rather than a credit account. But because of Ulticard's security, Lessin believes it will become more welcome than personal checks. "It will be accepted as cash," he says, "but cash that no one can steal as long as you keep your PIN secret."

Ulticard differs in several important ways from smart cards. Says Lessin: "Traditional smart cards have a very limited memory that cannot be erased. When it's full, the card must be replaced." Also, smart cards require a terminal. "That's very costly," he adds, "when you must buy hundreds of thousands and put them in all the stores and restaurants in the world that honor Visa."

Ulticard's memory is erasable. When it's full, you can make room for new data by deleting information no longer needed. A terminal is needed only when the card's accounts are updated for payments and automatic charges such as interest payments. This can be done with a modified bank automatic teller machine or other magnetic-stripe card reader.

Visa will begin testing Ulticard shortly. This will be a modest trial, using only about 100 of the first prototype pre-production cards. "It's designed to test whether card holders and merchants will accept the cards," says Lessin. But Visa is publicly committed to a larger market test provided that the results of the first trial are satisfactory. And even a small test is big news for Visa: In the past it had consistently rejected the idea of smart cards as a practical replacement for magnetic-stripe cards, even though its French affiliate, Carte Bleu, had issued them in France.

Of course, Visa is not the only major credit-card company trying out new technologies. In late 1985, MasterCard issued 70,000 French and Japanese versions of smart cards to cardholders in Palm Beach, Fla., and Columbia, Md. (The results of the test have not yet been made public.) And Ulticard's biggest competition may come from the Drexon Laser Card, made by Drexler Technology Corp., a firm located in Mountain View, Calif. Although Drexler's card contains no processing power and requires a personal computer, it can hold more than a million pieces of data permanently—the owner's credit information is literally burned into the card with a laser beam.

It's not yet clear which of the various technologies that are being developed will utimately become the standard for credit cards. "But if nothing else," says Lessin, "it is clear that the thirty-year-old standard credit card is in need of replacing." PS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# Two for your computer

## 1.Prolog for the PC

"This gives people hands-on experience with artificial intelligence," said Philippe Kahn. I watched as the reigning wizard of personal-computer software tapped a few keys on his IBM personal computer. Its screen divided into five colorful windows: one with a pull-down menu of commands, the others for entering instructions and displaying results. Kahn entered a 14-line program, with several lines of data, and in minutes he had created a simple—but artificially intelligent—address book.

Kahn was using Turbo Prolog, a $100 program sold by his company, Borland International (4585 Scotts Valley Dr., Scotts Valley, Calif. 95066). Like the original Prolog designed for large main-frame and mini-computers, Turbo Prolog is a language. It lets you create programs that use artificial intelligence to draw inferences, make conclusions, and act as a consultant or advisor in an expert system [PS, March]. But unlike the original Prolog, Turbo Prolog can be used on an IBM PC or compatible computer.

In Kahn's demonstration, the data included Borland's phone number and the fact that Kahn works there. I typed my question: *What is Kahn's phone number?*

In any standard data-base management system, the computer couldn't answer because its data base does not contain a phone number for Kahn. However, with Turbo Prolog the computer got the answer by drawing a conclusion about the data. It discovered that while no unique number existed for Kahn in the data base, he works at Borland—so it decided that Kahn could probably be reached there. In much less than a second, I saw Borland's phone number on the screen.

Turbo Prolog runs at speeds of up to 100,000 logical inferences per second. "That's up to 10,000 times faster than other expert programs developed for desk-top computers," said Kahn, "and about the same speed as prototypes of the Japanese fifth-generation computer now being developed." According to Kahn, the program gains its speed by bypassing the usual memory-management techniques built into the PC's hardware.

Turbo Prolog comes with a sample expert system called GeoBase. The system answers such questions as What is the highest mountain in Oregon and the closest city to it? Turbo Prolog also gives you an idea of how to build your own *smart* system. "With a month of practice," said Kahn, "even non-programmers will be writing major software, stuff that's really useful."

## 2.RAM disk for the Mac

Click. Click. With the Macintosh on-screen arrow pointed to the MacPaint program icon, I pressed the mouse button. Less than four *seconds* later the program was entered and I was ready to work. That kind of speed is awesome. But with a small add-on box called Disk Automation Storage Control Hardware (DASCH), it's becoming the new standard for Macintosh users.

DASCH is a random-access memory (RAM) disk. Attached to either the computer's printer or modem connectors, it provides massive blocks of RAM—from one-half to two megabytes—that the computer thinks is a disk drive. Data and programs are saved electronically in memory, not mechanically on a disk, allowing the Mac to operate up to seven times faster than it can using a normal disk drive, and about twice as fast as it does with a hard disk.

The one-megabyte unit I tried is big enough to hold four or five programs, a score of special Macintosh type fonts and desk accessories, and a dozen data files. Also, when hooked up to the Mac's printer connection and printer, the unit becomes a print buffer—it absorbs the file that is to be printed, freeing the Mac to do other work while printing is in progress. The size of the buffer can be selected, but I found it should be set for 100,000 bytes or more for best efficiency.

Like all RAM disks, using DASCH has one inherent danger: The stored data disappears in an instant if power is lost. RAM-disk users quickly learn to back up files onto regular disks. But in normal use, there's no reason to ever turn the DASCH off. It has its own AC adapter and draws just seven watts. It can be left on, even when Macintosh is off.

Developed by Western Automation Laboratories of Boulder, Colo., prices range from $395 to $545, depending on memory size. That makes the unit an inexpensive alternative to a hard disk, offering high speed and freedom from frequent floppy disk changes. —*Jim Schefter*



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AIR FORCE

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dish owners are so reluctant to become subscribers. First, a lot of people just resent being asked to pay for something they formerly got free. Perhaps even more important, prices are high —usually higher than costs of the same services delivered by cable. For example, subscriptions to the premium channels like HBO and Showtime, which were designed as add-ons to basic cable packages, cost about $12 a month. Cable subscribers, on the other hand, pay about $10. CNN costs individuals $25 a year, while cable systems pay about $2 a year for each customer.

Why do dish owners pay more, even though they buy and maintain their own equipment? Dish owners insist they aren't able to get fair prices because programmers are too dependent on the cable business. Programmers readily admit that they want to satisfy their cable franchises. "The cable industry controls the supermarket, and I am one of the products they sell," says Michael Fuchs, chairman of HBO. "I want to keep the distributors and the people who sell my product happy," he reasons, observing that the cable industry provides 99 percent of HBO's income. Fuchs says that cable companies even deserve cash rewards because their promotions have made consumers aware of his product. When a dish owner who lives in a cable franchise area orders HBO or Cinemax, the company pays $5 to the cable operator even if the subscriber orders directly from HBO.

Prodding by dish owners angered over this attitude has triggered a number of actions in Washington. The Senate Committee on Commerce, Science, and Transportation held a hearing at which Fuchs made the remarks noted above. The antitrust division of the Justice Department launched an investigation, and the Federal Communications Commission (FCC) filed a Notice of Inquiry.

These government proceedings have been filled with fireworks. "It's technological protectionism," charged Tennessee Senator Albert Gore angrily at the Senate hearing. He pointed out that the companies that own HBO and Showtime—Time Inc. and Viacom Networks—also own two of the 10 largest cable companies in the country and therefore have an interest in preserving cable's edge over the nascent satellite industry.

Yet most authorities agree that there will be little government action. The FCC has gone on record as favoring a "marketplace cure." Marketplace evidence so far is sparse. Two small signs: Showtime undercut HBO's price when it began scrambling, and HBO gives a price break for annual prepayments. To Mark Fowler, chairman of the FCC, these slim clues prove the market is working. "If the cost for a service is priced out of line with similar services or with its value to the customer, the programmer will have to improve its offering, lower its prices, or face the severe discipline of the marketplace—business failure," Fowler argues. Not everyone agrees.

## Packagers—new trend

In today's marketplace, ordering services can be a big nuisance. Although a single descrambler works for the majority of scrambled channels, until recently you had to deal with every programmer separately—unless you lived near a cable outfit that was willing to handle your account. Now, two cable companies have introduced packages, groups of signals sold together at a lower cost than if they were ordered separately. One package sold by Tele-Communications Inc. has already been marked down to about

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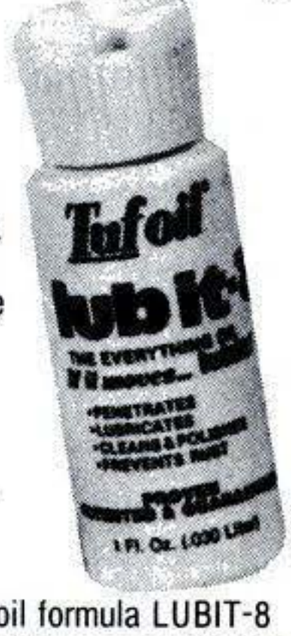


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It is significant that the programmers made packaging arrangements with cable companies—their prime customers. They have been unwilling so far to do so with others. For example, they have already been approached by coalitions of satellite-equipment dealers and distributors who want to create national packages, but they haven't negotiated any deals.

Nor have they agreed to perhaps the most ambitious scheme of this type to date—a plan put forward by the National Rural Electrical Cooperative Association (NRECA), which represents electric cooperatives providing power to 25 million Americans in 46 states. "We bring a tremendous market to the programmers that they would not be able to reach otherwise," says Jack Wood, the NRECA's project manager for telecommunications.

The NRECA wants to provide programs to rural Americans who can't get cable; 75 percent of its consumers aren't wired. The association intends to put together a basic package of several "superstations" (local stations like Ted Turner's WTBS that gain a nationwide audience when they begin broadcasting via satellite), a sports channel, a news channel, and a family-oriented movie channel for $10 a month. The programmers say they are willing to talk to the NRECA, but it seems doubtful at this time that they'll give the cooperatives a low group rate.

And there is another reason the programmers will move cautiously—if at all—toward putting together package deals for dish owners: HBO and Showtime want the business for themselves. "We want to make a retailer's profit," says Bob Caird, HBO's vice president of direct broadcast (and a dish owner). For each home viewer who subscribes directly through HBO, the company receives nearly twice what it gets from a wholesale cable subscription. Home earth stations offer programmers an attractive new market. The cable industry—with 40 million subscribers—dwarfs the dish market, but cable's growth years are over. Satellite antennas can receive a greater variety of information, and they can reach the estimated 30 million people who will never have access to cable.

Thus, while many uncertainties remain, there is some optimism that satellite-industry growth—interrupted abruptly by the advent of scrambling—is coming back. Satellite hardware is cheaper than it's ever been, even when the cost of a decoder is included. Industry analysts expect that 200,000 TV dishes will be sold during the second half of 1986, twice as many as during the first half.

### The future

While some elements of the complex picture are falling into place, long-range changes are likely. The M/A-Com descrambler, for example, has been accepted nearly universally as a standard. Yet it now faces a legal battle. Oak Industries, another descrambler manufacturer, has filed a lawsuit that charges M/A-Com infringed on three of its patents, and asks for an injunction against sales of all M/A-Com descramblers. HBO and Showtime have spent almost $25 million on the M/A-Com system, but they're not obligated to keep using it. Showtime has a clause in its licensing policy that says it reserves the right to "utilize other distribution mechanisms, frequencies, or technologies."

Eventually, satellite TV may shift to an entirely different band. Today, most satellite systems transmit on what is called the C-band, a frequency spectrum lying between 4,000 and 8,000 megahertz (MHz). The satellites now


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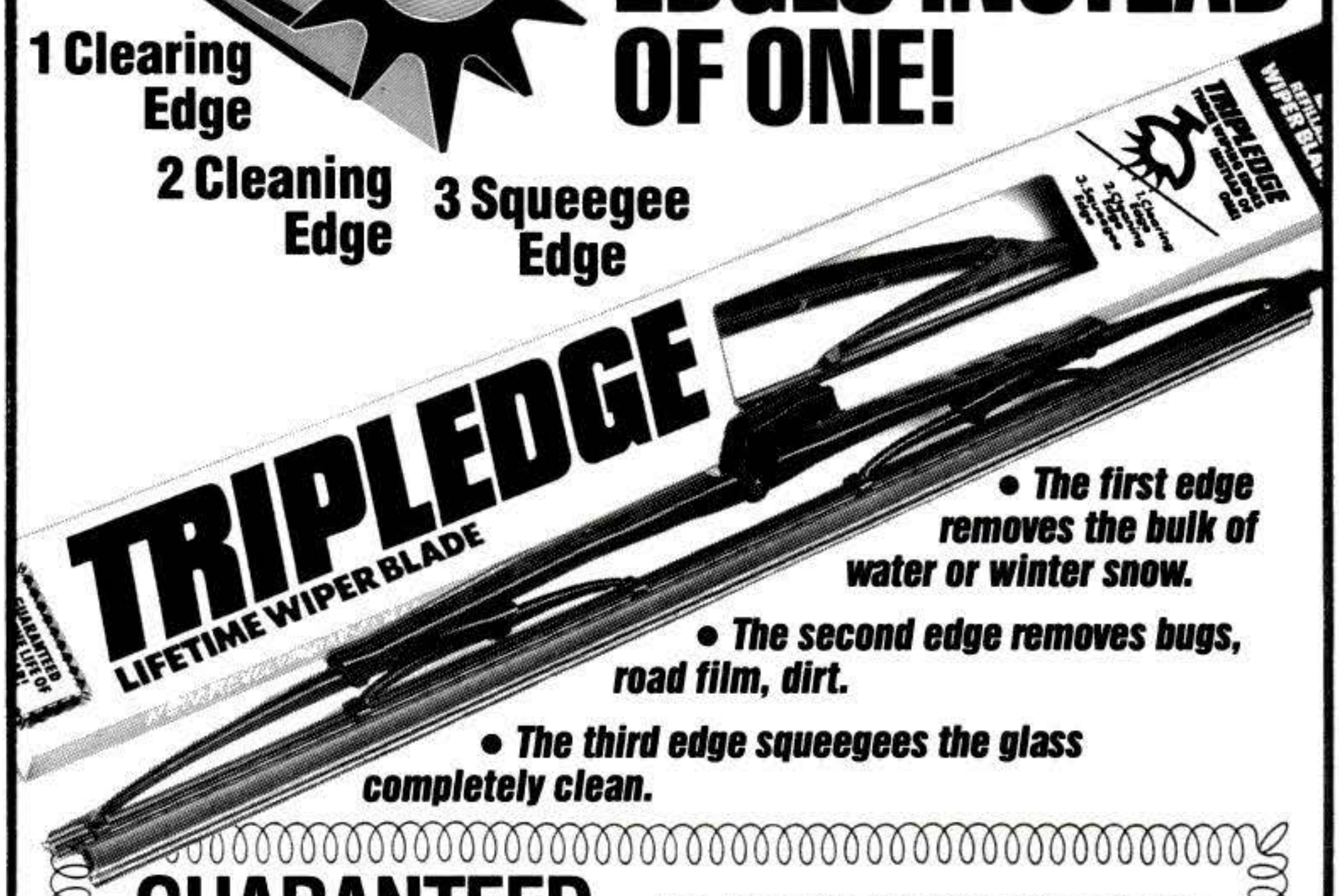


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in orbit that transmit in this band will last another decade at most. Sometime between now and then, some or all satellite TV transmissions may switch over to the higher-frequency Ku-band (12,000 to 18,000 MHz). HBO is already sending scrambled feeds on the Ku-band to some cable operators, and has entered into an agreement with RCA to purchase a Ku-band satellite.

How will this affect dish owners? Programmers say they have no plans to offer Ku-band transmissions to dish owners, but any such plans would be far in the future. They claim they are switching to the new band to lower costs for cable operators because the Ku-band antennas are smaller, cheaper, and less susceptible to terrestrial interference—which is especially troublesome in urban areas. These features also make Ku-band dishes attractive to city dwellers, cable's captive audience.

## Owners strike back

Dale Hanson, who lives in a canyon two miles outside Albuquerque's city limits, couldn't watch TV until he bought a satellite antenna in 1981. He can see eight more dishes from his front yard. "There are people out there literally starved for information," he says. Not surprisingly, Hanson has become part of an army of earth-station enthusiasts fighting for legislation that would mandate access to signals and force programmers to establish sales formulas.

Hanson and his fellow "bird watchers" are also pursuing another alternative: They're encouraging dish owners to become their own programmers. "We're trying to open up a whole new can of worms," says Shelley Morris, vice president of Home Dish Programming of Sanborn, Minn. The company hopes to offer four channels, charging an initial $95 fee and $8 a month. But industry experts doubt whether Home Dish has the financial backing to succeed (leasing one satellite transponder, or channel, costs $75,000 a month).

Although their plans to broadcast television signals by satellite are shaky, dish advocates are already using satellites to broadcast another service: radio. Their transmissions consist mainly of talk shows about satellite equipment and the scrambling issue; the shows have evolved into national clubs for home earth-station owners.

There is plenty of room in space for audio signals, and many are delivered in high-quality stereo sound. Each of a satellite's 24 transponders can carry one video signal plus two or more audio subcarriers. Picture the video as a truck going down the highway: The subcarrier is like a motorcycle driving beside it in the same lane.

FM America, the first radio station on satellite, has more than 40,000 members—mostly dish owners. Keith LaMonica, the president, often gets letters from wives complaining that their husbands are using expensive satellite setups as radios. And he hears from a few listeners who don't like to watch the XXX movies that appear on the video channel of which FM America is a subcarrier. But most listeners are boosters. They believe that, despite conflicts over the cost of scrambled programming, home earth stations are here to stay.

I called FM America and, on the air, asked listeners whether they would buy dishes again, knowing what they now know. The answer was an emphatic yes from everyone who responded. Some complained about poor service from cable companies, or said they couldn't get cable at all. Bob, a caller from Virginia, was typical of satellite TV's growing circle of aficionados. "Would I buy another one?" he asked. "I'd buy twelve of 'em if I had the money!" PS


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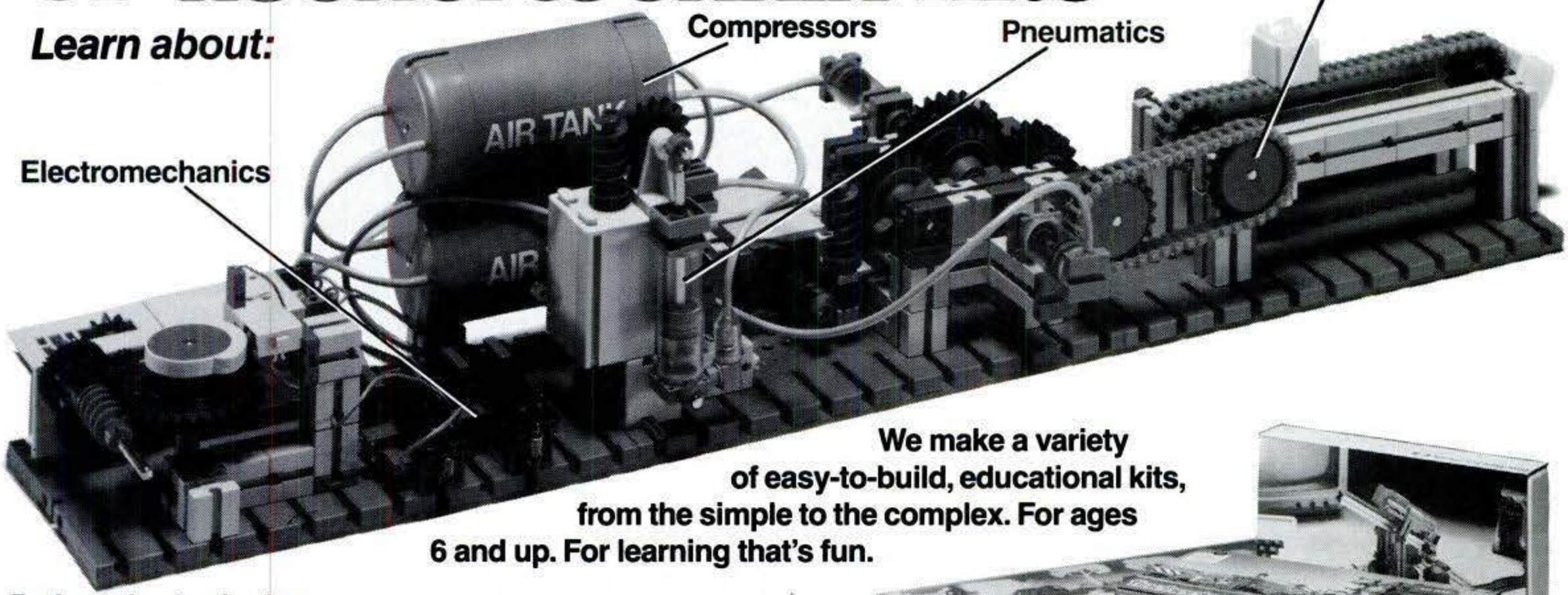


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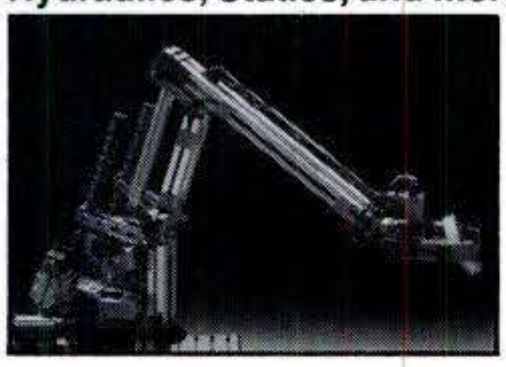

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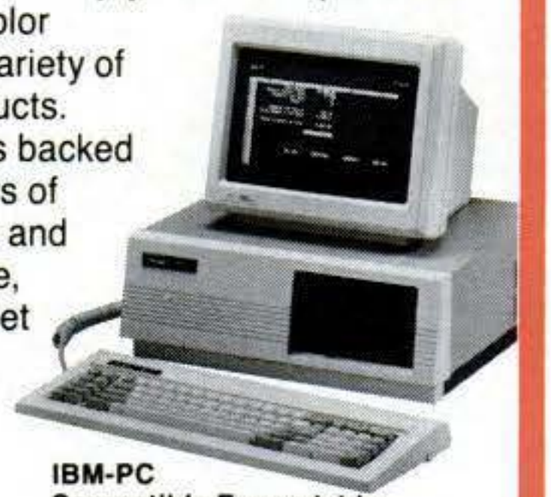

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## Unsmart chip

I have a 1985 Chevrolet Celebrity with a 2.5-liter fuel-injection engine. This engine got me 37 mpg 8,000 or 9,000 feet up in the Rocky Mountains last summer. Down here at sea level I am only getting 29 mpg. Also, the car does not slow down when I remove my foot from the accelerator. The dealer's mechanic says this is typical and characteristic of the fuel pump. There is no adjustment, he says, and braking is the only way to slow the car.

S. T. Shaw, West Melbourne, Fla.

*Sounds like your engine is programmed to get too much fuel at sea level, it's running rich. If there's a fix, it's another PROM [programmable read-only memory] chip for your engine-control computer, and only Chevy would have it. The too-fast idle is also controlled by the PROM, making Chevrolet the only source for a cure.*

## Short-lived points

I own a 1971 Opel GT. It is my second one, and I had the same problem with the first: It burns points very, very quickly. Other Opel owners tell me they have the same problem. The Opel dealer and foreign-car garages don't know why they burn so quickly. I was told by one auto-parts store to put in a ballast resistor to drop the voltage entering the distributor. It didn't work. The car still loses its tune after four or five weeks, and I have to replace the burned, pitted points. I'm baffled.

Ted Schaffer, Terre Haute, Ind.

*Points don't like oil, fuel vapors, or ozone. Try drilling a 1/4- to 3/8-inch hole in the distributor cap to ventilate it. Gas fumes from a leaking vacuum advance unit could cause this problem. So could bad distributor bushings. Also, check to be sure that the points have a good ground and correct polarity, that the correct condenser is installed, and that voltage to the coil is on spec.*

## Curing noisy lifters

My 1980 American Motors Concord develops a loud lifter noise after several months of making short local trips, especially during the winter months. Solvents and additives do a creditable job of alleviating or reducing the clatter. For a really stubborn case, I find that a 100-mile trip on the Autobahn at a sustained speed of 75 mph usually clears the clatter completely. Any explanations?

Nick Ovuka
Stadtbergen, West Germany

*Nearly all hydraulic-valve-lifter problems come from dirt or metal shavings carried in by the oil. The exception would be in a worn engine that couldn't maintain sufficient oil pressure. Chemical cleaners will certainly solve some dirty-lifter problems. A period of high-speed driving can also help to flush contamination out of the lifters. For a really severe case, however, the only true fix is to disassemble the engine, clean it, and reassemble it.*

## Misses when cold

My 1980 Honda, which has 70,000 miles on it, misses terribly on most mornings until I have driven four or five miles; thereafter it runs smoothly. The problem began when the car had 25,000 miles on it, and neither the dealer nor a service station could fix it. Then it resolved itself spontaneously several thousand miles later. Recently, the problem has returned.

David Pate, Mobile, Ala.

*It could be lots of things. First, give the engine a cylinder-leakage test when it's cold to see if it leaks compression at start-up. Then crank the engine in the dark when it's cold and look for any stray sparks that might be jumping around. Here are some possible causes: over-rich or over-lean fuel mixture during cold running; a compression ring or valve that sticks when cold; or a slight intake system leak or water leak that clears up at higher temperatures.*

## Those EPA numbers

Have the current EPA gas-mileage figures progressed to the point that they are taking aerodynamic drag into account, or are they still the results of tests run on cars that are standing



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still? In other words, if there are two cars with very different aerodynamic characteristics but with the same engine, would they have the same EPA numbers?

Also, what is your position on "freedom batteries," which are never supposed to need servicing. I recently had one that ran low on water and had to be replaced.

Larry E. Nazimek, Chicago, Ill.

*Although EPA mileage is checked on rollers with the car not moving, the results of the tests used now are pretty accurate. The actual road load, including the aerodynamic characteristics of each car, is calculated and applied to the rollers during the test cycle.*

*A good-quality no-maintenance battery works when everything in the charging system is functioning properly. But in real life, it seems as if we're having more battery trouble than before. This is because new cars are so electricity-hungry that they require much larger charging systems that work the batteries a lot harder. Cars in cold climates are particularly affected. Every time you start a car at below-freezing temperatures, it's hard on the battery.*

## Sludge grudge

What is the best way to clean a badly sludged engine without taking it apart?

Robert Greenough
St. Petersburg, Fla.

*You won't like my answer. There's only one right way to do it: Disassemble the engine, clean the parts, and replace those that are worn. If you use a sludge-removing chemical to release all of the accumulated sludge at once, there's a good chance that the oil will become contaminated, and major damage could result.*

## Knocking T-bird

I have a 1981 Ford Thunderbird with a 302 engine that has gone 22,000 miles. Ever since the car was new, it has knocked badly on the slightest acceleration. The dealer assures me that all adjustments are on spec, and advises me to use high-test gasoline. Does this make sense to you?

E. J. Ames, Duluth, Minn.

*Be sure that your exhaust-gas recirculation (EGR) system is working properly. If the engine only knocks under light loads, you might consider having the spark-advance curve modified. Two pieces of advice: First, this is a job for a really good ignition technician. Second, changing the ignition system will alter the emissions characteristics of the engine. My guess is that it will improve them, but remember that it's illegal to make modifications that result in emissions that exceed standards for the year the car was built. If the engine also knocks under heavy loads such as hill climbing or rapid acceleration, burning higher-octane fuel is a cure.*

## Brake noise

I have a 1980 Honda Accord five-speed with 100,000 miles on it. When it is rainy or damp, there is a scraping noise that comes from the right rear wheel. The noise is frightening. The Honda garage says it is only dust.

Mrs. W. J. Leskiewicz
Lynnfield, Mass.

*The noise coming from the damp or wet brake is probably caused by glazed linings covered with an accumulation of road dirt and grease. High-mileage linings can become quite glazed and hard, producing all kinds of noise. The drum also may be worn, and some of the brake-retainer parts may be worn or frozen. Have the rear brake examined and repaired as necessary.*

## Oils for diesels

I've just installed a new engine in my 1979 Oldsmobile diesel, and I'd like to know what type of oil I should use in the engine. I've always thought that an oil with the service classification CD was best for a diesel engine, but my owner's manual says not to use an oil that has the CD marking on the can. I've asked some dealers about this, but none have been able to give me an answer. Can you help?

Robert Gorski, Sherman, N.Y.

*General Motors says that oils that carry the label SF,CD (together) are best for diesel engines. Oil labeled SF,CC is second choice, but not the best. Oil labeled SD,SE,CA,CB is acceptable, but only when it also says SF,CD,CC. Do not use any oil that is labeled only SF or CC. In moderate temperatures, use straight SAE 30 oil. These engines thrive on heavier oil; use SAE 10W-30 or 15W-40 only in cold weather. Also, don't use 10W-40 oil in diesels.*

Got a car problem? Send it to "Say, Smokey—," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. All letters are read, and those of widest interest are answered in this column. Due to the large volume of mail, Smokey cannot reply to letters not selected for publication.


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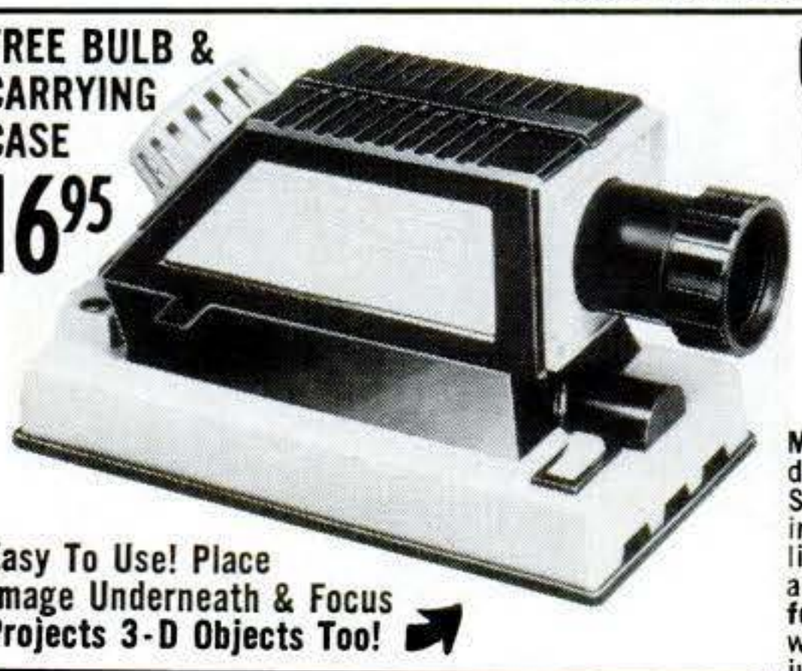

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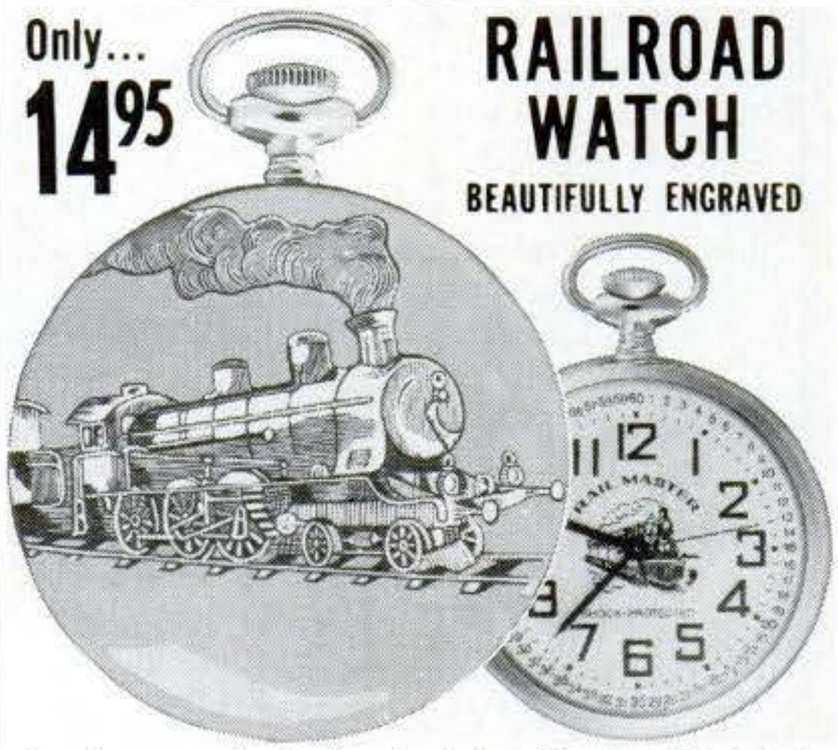

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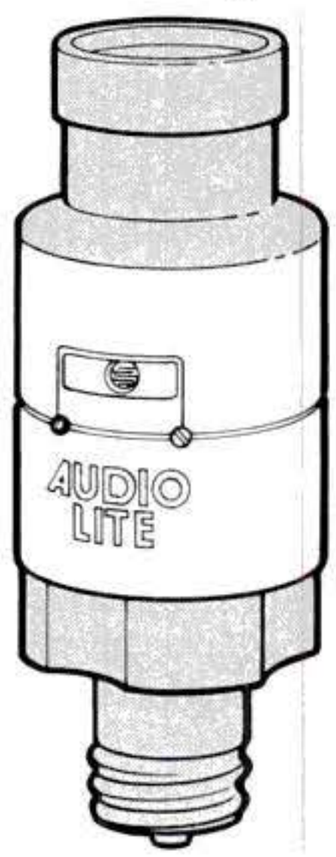


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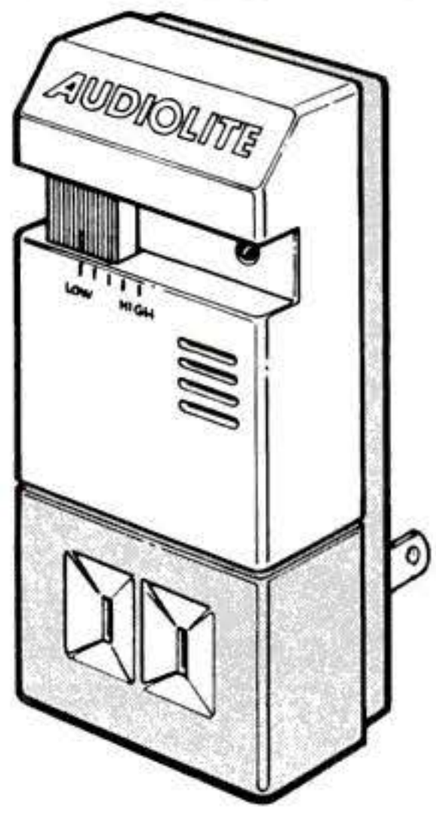


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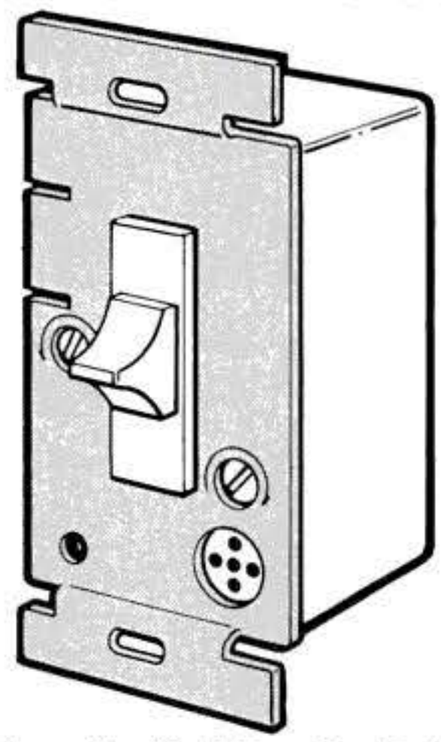

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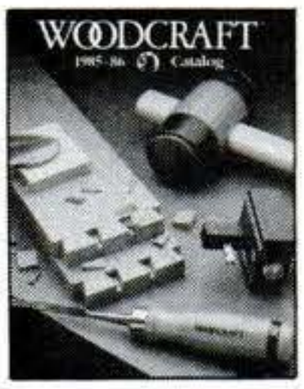


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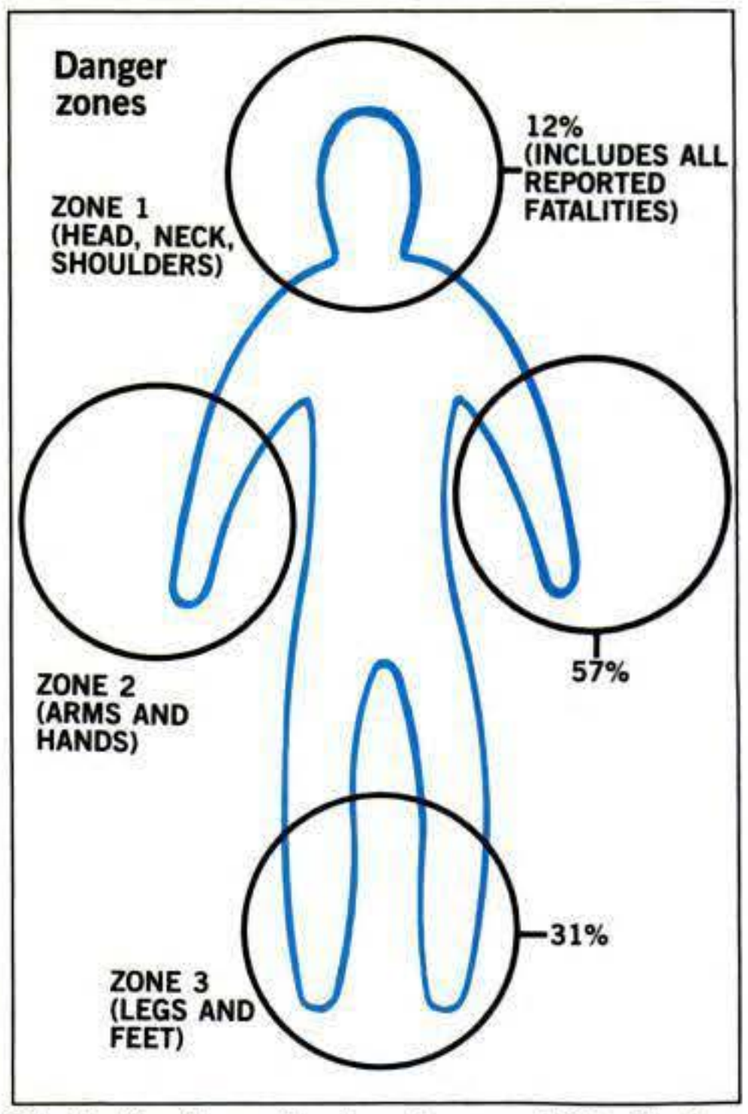
## Safer chain saws

[Continued from page 60]




**Statistical analysis of over 300 chainsaw injuries (25% due to kickback) indicates limitation of built-in safety factors. Zone I injuries—all kickback related—account for only 12% of total, but all of the fatalities, from deep cuts on the head or throat. Zone 2 and 3 injuries are rarely fatal. Heavy gloves and proper grip would lessen zone 2 injuries, as will hand guards now mandatory on consumer saws. But safety devices cannot lessen zone 3 injuries, caused by careless handling—improper stance or failing to shut off a saw while carrying. Chaps and boots offer the best protection here.**

agree that the key to safety remains with the operator.

"Our emphasis is on *prevention* of kickback," Paul Watson, Homelite's director of product safety, told me on a tour of the Charlotte, N.C., plant, "not only with our tip guard but with proper education. It beats depending on a mechanical safeguard like a chain brake."

Later, spokespeople from Stihl also stressed education, pointing out the company's program of dealer training and consumer seminars, safety films available to service clubs, and its line of safety clothing and accessories such as log tongs and break bars. Stihl also sponsors Swedish logging expert Soren Erikson's demonstration of safe logging practices and attire. (Erikson showed me how fiber-padded clothing can choke off a saw—see photo.)

Over the years, POPULAR SCIENCE has published a number of articles on safe chain-sawing; all the precautions outlined still apply to the new saws and chains. The question I asked the experts was, Are there *special* procedures that can make post-Standard chain saws even safer

*Continued*



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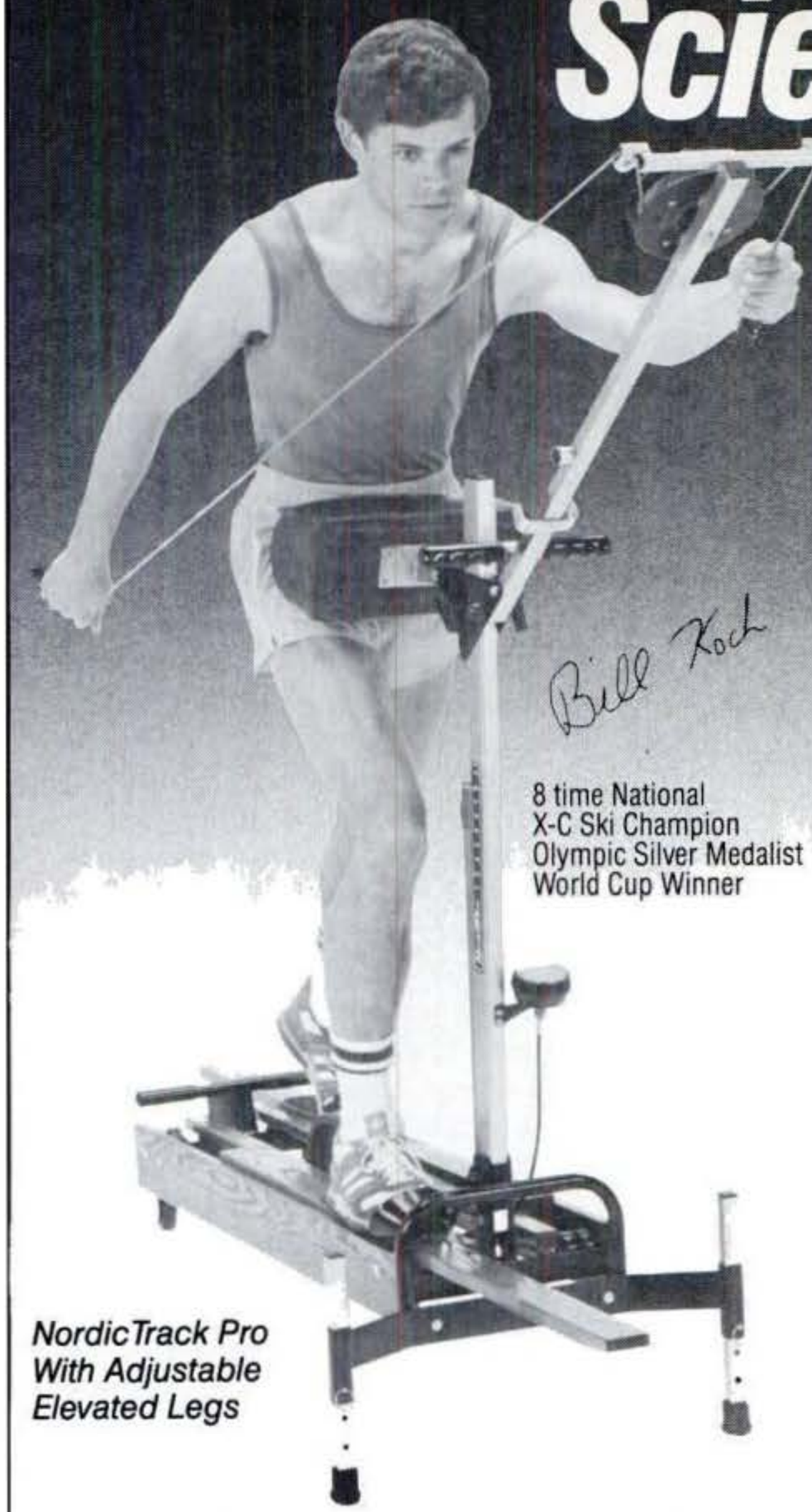
# Scientific study ranks NordicTrack #1




NordicTrack Pro
With Adjustable
Elevated Legs

***In tests of exercise efficiency at a major university, NordicTrack burned more calories and provided greater aerobic workouts.***

**The Rank in Order of Exercise Efficiency:**

1. **NordicTrack**
2. **An Exercise bike**
3. **A Rowing machine**
4. **A Shuffle type ski exerciser**

*Scientific abstract available upon request*

*All Exercise Devices Were Tested 4 Times:*
*at 3 different heart rates and at maximum work.*

*Tests Measured:*
*Volume of oxygen consumed which indicates calories burned.*

*Data was scientifically analyzed at the University Human Performance Laboratory.*

*Results:*
*On all 4 tests, NordicTrack burned more calories and yielded significantly greater cardiorespiratory workouts.*

## It's Only Logical that NordicTrack Would Get the Highest Scores

### because NordicTrack is more complete than an Exercise Bike.

*NordicTrack adds important upper body exercise.*
*NordicTrack provides more uniform leg muscle usage.*
*Higher pulse rates, necessary for building fitness, seem easier to attain because more muscles share the exercise.*

### because NordicTrack provides more thorough exercise than a Rowing Machine.

*Standing position involves more muscle mass than sitting position.*
*NordicTrack uses large muscles of buttocks, thighs and calves to simultaneously bear body weight and work against resistance.*
*NordicTrack resistance is proportioned to individual muscle strength.*
*Stronger legs use greater resistance.*
*Arm resistance can be set at lighter setting separately.*
*NordicTrack is safer — no high back strain loads are imposed.*

### because NordicTrack has inertial resistance not available on a Shuffle-Type Ski Exerciser.

*Flywheel provides life-like feeling; Smooth, Continuous.*
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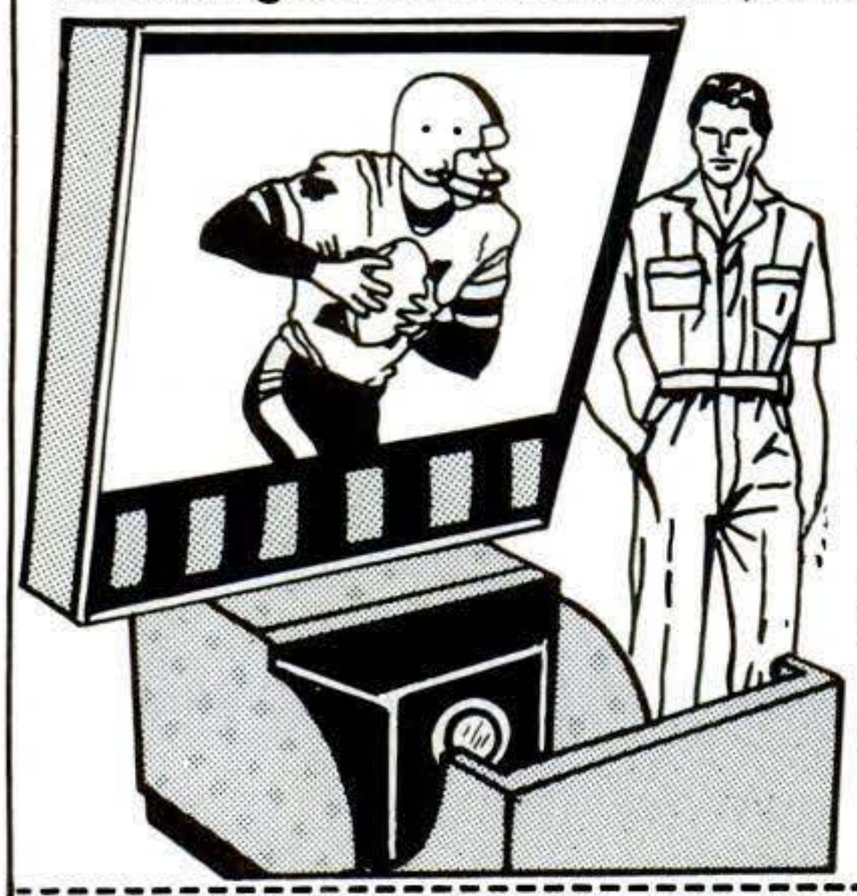

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## Safer chain saws

*Continued*

around the home? Here's a summary of the responses.

Don't be lulled into a sense of false security by all the new emphasis on built-in safety. The Standard addresses only kickback, and that's the cause of less than a quarter of all chain-saw accidents. Hazards remain, and there are absolute no-nos for casual users:

- Never borrow, rent, or lend a chain saw without proper instruction. The owner's manual should accompany the tool. And if you haven't yet read the one that came with your saw, do so.
- Never use a chain saw when you feel fatigued, or with children or pets in the area.
- Never smoke while operating a gas-powered tool.
- Never adapt a consumer chain saw for a bow guide. These elliptical chain rails are for use only by professional cutters because their broad, blunt nose greatly increases the size of that dangerous upper quadrant.
- Don't relax your maintenance procedures. Some chain makers claim that correct filing is even more critical with low-kickback chains because you can diminish the chain's effectiveness if you distort its shape. (For filing tips, see "New Anti-kickback Chains," PS, June '85.)

But when I checked this with Donn Lawty, technical editor of the trade magazine *Chain Saw Age,* he pointed out that the design of the cutter has remained essentially the same: The anti-kickback components have been *added* to the chain. You still file the cutters the same way.

"The problem," Lawty says, "isn't that there's anything *new* about chain maintenance. The problem is that homeowners have never maintained their saws properly in the first place. Most of them don't have enough cutting experience to spot a dull chain."

A major distributor of chain saws and safety apparel told me the prob-

*Continued*

**Saws with a step-through rear handle like this one are safest to start. Don't yank cord while holding saw in midair.**

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**(R29380)**

(R29980)

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The most expensive reel sold by this huge firm, it is yours for only $2 if you act before December 17. (R25166)

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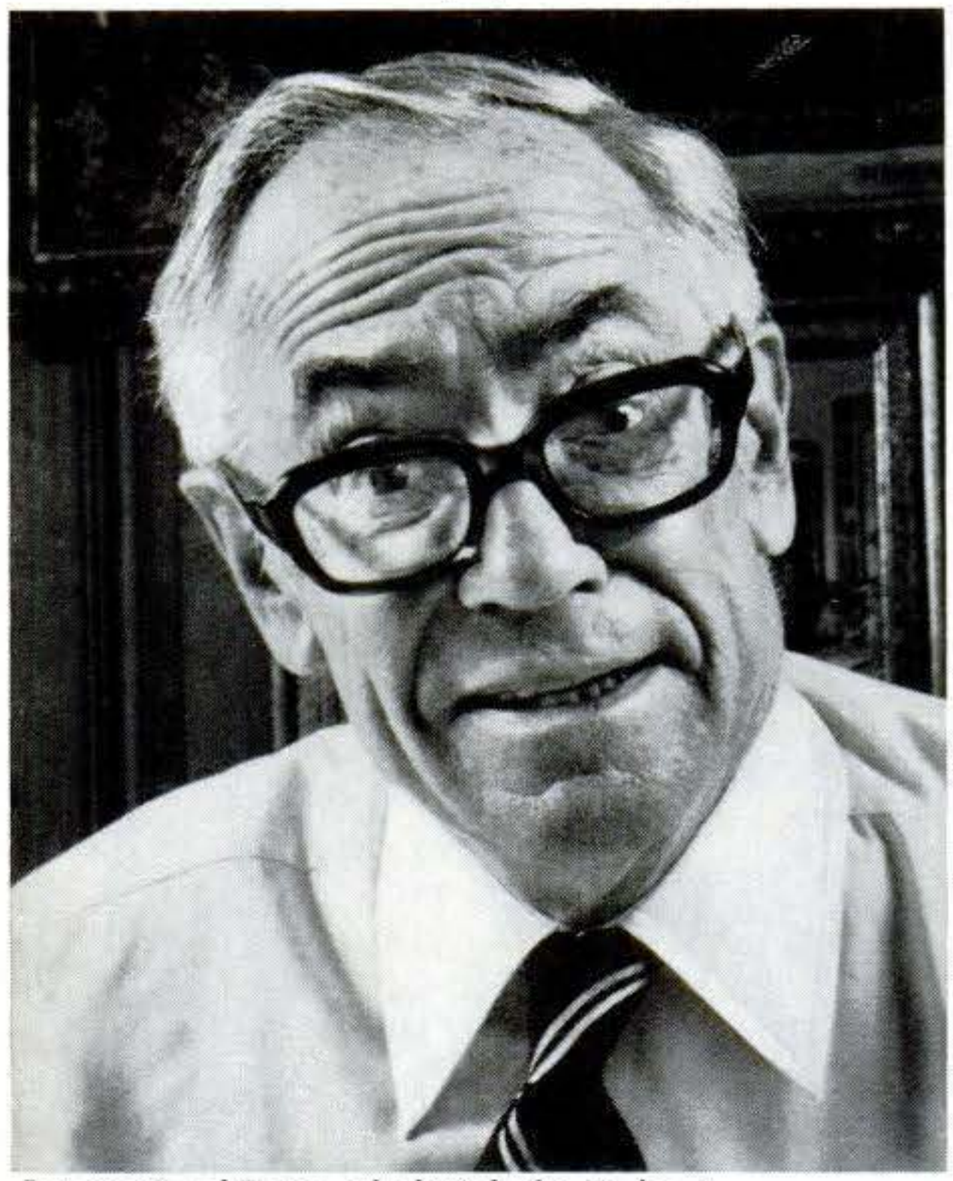
# How to write a business letter

## Some thoughts from Malcolm Forbes

*President and Editor-in-Chief of Forbes Magazine*



*International Paper asked Malcolm Forbes to share some things he's learned about writing a good business letter. One rule, "Be crystal clear."*

A good business letter can get you a job interview.

Get you off the hook.

Or get you money.

It's totally asinine to blow your chances of getting *whatever* you want—with a business letter that turns people off instead of turning them on.

The best place to learn to write is in school. If you're still there, pick your teachers' brains.

If not, big deal. I learned to ride a motorcycle at 50 and fly balloons at 52. It's never too late to learn.

Over 10,000 business letters come across my desk every year. They seem to fall into three categories: stultifying if not stupid, mundane (most of them), and first rate (rare). Here's the approach I've found that separates the winners from the losers (most of it's just good common sense)—it starts *before* you write your letter:

### Know what you want

If you don't, write it down—in one sentence. "I want to get an interview within the next two weeks." That simple. List the major points you want to get across—it'll keep you on course.

If you're *answering* a letter, check the points that need answering and keep the letter in front of you while you write. This way you won't forget anything—*that* would cause another round of letters.

And for goodness' sake, answer promptly if you're going to answer at all. Don't sit on a letter—*that* invites the person on the other end to sit on whatever you want from *him*.

### Plunge right in

Call him by name—not "Dear Sir, Madam, or Ms." "Dear Mr. Chrisanthopoulos"—and be sure to spell it right. That'll get him (thus, you) off to a good start.

(Usually, you can get his name just by phoning his company—or from a business directory in your nearest library.)

Tell what your letter is about in the first paragraph. One or two sentences. Don't keep your reader guessing or he might file your letter away—even before he finishes it.

In the round file.

If you're answering a letter, refer to the date it was written. So the reader won't waste time hunting for it.

People who read business letters are as human as thee and me. Reading a letter shouldn't be a chore—*reward* the reader for the time he gives you.

### Write so he'll enjoy it

Write the entire letter from his point of view—what's in it for *him*? Beat him to the draw—surprise him by answering the questions and objections he might have.

Be positive—he'll be more receptive to what you have to say.

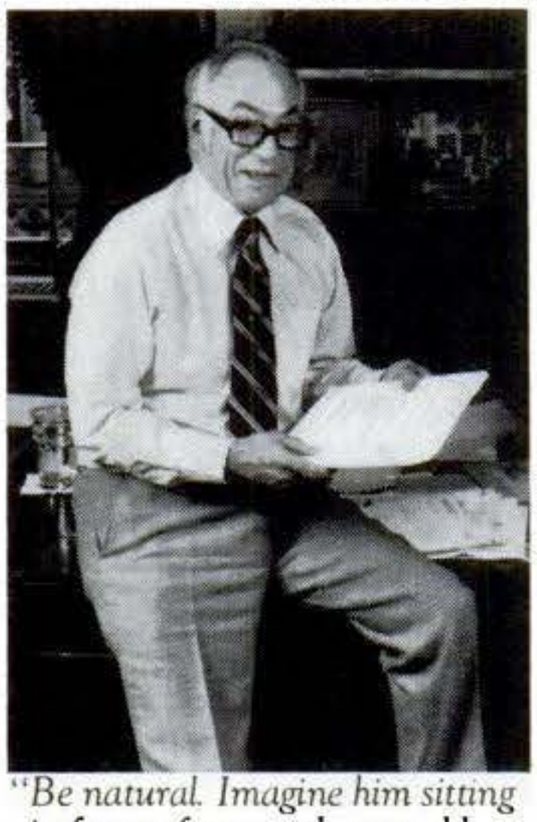
Be nice. Contrary to the cliché, genuinely nice guys most often finish first or very near it. I admit it's not easy when you've got a gripe. To be agreeable while disagreeing—that's an art.

Be natural—write the way you talk. Imagine him sitting in front of you—what would you *say* to him?

Business jargon too often is cold, stiff, unnatural.

Suppose I came up to you and said, "I acknowledge receipt of your letter and I beg to thank you." You'd think, "Huh? You're putting me on."

The acid test—read your letter *out loud* when you're done. You might get a shock—but you'll know for sure if it sounds natural.



*"Be natural. Imagine him sitting in front of you—what would you say to him?"*

Don't be cute or flippant. The reader won't take you seriously. This doesn't mean you've got to be dull. You prefer your letter to knock 'em dead rather than bore 'em to death.

Three points to remember:

Have a sense of humor. That's refreshing *anywhere*—a nice surprise

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in a business letter.

Be specific. If I tell you there's a new fuel that could save gasoline, you might not believe me. But suppose I tell you this:

> "Gasohol"—10% alcohol, 90% gasoline—works as well as straight gasoline. Since you can make alcohol from grain or corn stalks, wood or wood waste, coal—even garbage, it's worth some real follow-through.

Now you've got something to sink your teeth into.

Lean heavier on nouns and verbs, lighter on adjectives. Use the active voice instead of the passive. Your writing will have more guts.

Which of these is stronger? Active voice: "I kicked out my money manager." Or, passive voice: "My money manager was kicked out by me." (By the way, neither is true. My son, Malcolm Jr., manages most Forbes money—he's a brilliant moneyman.)

*"I learned to ride a motorcycle at 50 and fly balloons at 52. It's never too late to learn anything."*

## Give it the best you've got

When you don't want something enough to make *the* effort, making *an* effort is a waste.

Make your letter look appetizing—or you'll strike out before you even get to bat. Type it—on good-quality 8½" x 11" stationery. Keep it neat. And use paragraphing that makes it easier to read.

Keep your letter short—to one page, if possible. Keep your paragraphs short. After all, who's going to benefit if your letter is quick and easy to read?

You.

For emphasis, underline important words. And sometimes indent sentences as well as paragraphs.

> Like this. See how well it works? (But save it for something special.)

Make it perfect. No typos, no misspellings, no factual errors. If you're sloppy and let mistakes slip by, the person reading your letter will think you don't know better or don't care. Do you?

Be crystal clear. You won't get what you're after if your reader doesn't get the message.

Use good English. If you're still in school, take all the English and writing courses you can. The way you write and speak can really help—or *hurt*.

If you're not in school (even if you are), get the little 71-page gem by Strunk & White, *Elements of Style*. It's in paperback. It's fun to read and loaded with tips on good English and good writing.

Don't put on airs. Pretense invariably impresses only the pretender.

Don't exaggerate. Even once. Your reader will suspect everything else you write.

Distinguish opinions from facts. Your opinions may be the best in the world. But they're not gospel. You owe it to your reader to let him know which is which. He'll appreciate it and he'll admire you. The dumbest people I know are those who Know It All.

Be honest. It'll get you further in the long run. If you're not, you won't rest easy until you're found out. (The latter, not speaking from experience.)

Edit ruthlessly. Somebody ~~has~~ said that words are ~~a lot~~ like inflated money—the more ~~of them that~~ you use, the less each one ~~of them~~ is worth. ~~Right on.~~ Go through your entire letter ~~just~~ as many times as it takes. ~~Search out and~~ Annihilate all unnecessary words, ~~and~~ sentences—even ~~entire~~ *paragraphs*.

*"Don't exaggerate. Even once. Your reader will suspect everything else you write."*

## Sum it up and get out

The last paragraph should tell the reader exactly what you want *him* to do—or what *you're* going to do. Short and sweet. "May I have an appointment? Next Monday, the 16th, I'll call your secretary to see when it'll be most convenient for you."

Close with something simple like, "Sincerely." And for heaven's sake sign legibly. The biggest ego trip I know is a completely illegible signature.

Good luck.

I hope you get what you're after.

Sincerely,

Malcolm S. Forbes

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**Variation on nose guard prevents kickback and provides stabilizing prongs to imbed in ground or adjacent log for a pivoting cut. Utilitip is one of new Standard's anti-kickback devices.**

lem can be worse than that: "We've had casual users put their chain on *backward*. And—want to hear something ironical? Several of the new safer chains *increase* the severity of kickback over ordinary chains if you happen to mount them backward!"

• Don't take built-in chain brakes for granted. You must keep their mechanism clean of oily sawdust and other debris if they're to work decisively.

A large part of the education programs undertaken in conjunction with the new safety standard is devoted to labeling. All power heads are now marked with a warning that tells users to follow the manual's safety precautions. Manufacturers are making warnings impossible to miss. Several have adopted a color-code system so that users must deliberately *choose* a saw or chain that lacks the anti-kickback features. Unfortunately, there's no uniformity in color coding. Chain makers seem almost perverse in the range of colors they've chosen to identify low-kickback chains: Windsor joins Stihl in using a green label; Oregon (Omark) is blue; Townsend, yellow; and Carlton, oddly enough, flags its safer chains red.

It's worth your effort to make sure that any replacement chain you buy is a low-kickback design—even if you're mounting it on a pre-Standard saw. You might even want to consider replacing your old guide bar.

A final word: Because the new standard places responsibility for education on the dealer, don't be surprised if yours asks you to sign an acknowledgement that he's explained the difference between low-kickback features and the more aggressive chain (or saw) that you're insisting on buying. It's for his own liability defense, and it's appropriate, isn't it, that you assume responsibility for the added risk you're taking upon yourself? PS



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## Shredder showdown

[Continued from page 69]

stacked on a vertical shaft so that it chops debris like a food processor.

Unfortunately, the 4-hp 5000B was also the most disappointing. The shredding mechanism spit out leaves virtually untouched, and many times large twig pieces came flying out. The chipper feature would only accept small green branches, and anything approaching its two-inch capacity was too much for it.

The two other mid-size units, the 3-hp Scotchmen SC603 and the 5-hp Speedy Esquire, were fair performers. They both are hammer-mill shredders, but only the Scotchmen has a separate chipper. The 16 flails on the Esquire do a good job of chopping up cuttings. But the machine is somewhat crude—the most old-fashioned of the group. The oil drain and oil fill cap are almost inaccessible, for example, and it has no provision for preventing blowback: When you put material into the shredding chute, debris shoots out the top in all directions. Other machines use a plastic flap of some kind to keep waste in the shredding compartment.

The 12-flail Scotchmen was a fair shredder at best. Leaves and pieces of twigs tended to get through unscathed. Its chipper was impressive, though, aggressively chewing limbs up to its maximum 1¾-inch capacity. Like the Esquire, this machine was not sophisticated. The castings of a number of its parts were crude, for instance, and its wheels were small.

The last two machines, the 8-hp Super Tomahawk and 7-hp Mighty Mac, turned in problem-free performances. I was skeptical of these units because the manufacturers boast three-inch chipping capacities, but both machines did the job handily. In fact, the Tomahawk surprised me with its aggressiveness: When I shoved a thick branch into its chipper funnel, the machine sucked it in with such force that I was taken off guard. The Tomahawk is lighter and more compact than other heavyweight shredders, and, with its large, thick wheels, it is easy to maneuver. It is well put together and, with a 16-flail hammer mill, a thorough shredder.

The Mighty Mac chipped everything I fed it, but not with the gusto of the Tomahawk. It has 24 flails, though, so it is an excellent shredder. With its horizontal layout, wheelbarrow-like handles, and rearward center of gravity, it was extremely easy to move.

Shredders have come a long way in the last few years. You don't have to either settle for a big machine or do without. Between the new imports and the old standbys, there's now a shredder for every need. PS


# Guard Your Family Against Old Man Winter With Chill Buster Window Insulating Systems

### Chill Buster I System

Creates insulating air pocket that protects you and your family from drafts and chills. Available in **white** or **brown.**

Chill Buster I uses interlocking inside fastener strips that give windows a "finished" look. Simply snap film in place between interlocks and shrink with hair dryer to form tight seal.

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| 75 Ft. long & 200 Ft. Fastener | #IF-102 **$49.95** | #IF-202 **$52.95** | #IF-302 **$67.95** |

**Patio Door/Picture Window Size** — 84 In. x 9 Ft. & 35 Ft. of Fastener - Stock #PIF-101 Cost: **$9.95**

### Chill Buster II System

**Kit Contains Everything You Need!**

Low-cost tape-on system installs in minutes with double-sided tape. No measuring, no cutting. Chill Buster Systems give you added protection and comfort.

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| 50 Ft. long & 150 Ft. Tape | #HW-102 **$17.95** | #HW-202 **$18.95** | #HW-302 **$22.95** |
| 75 Ft. long & 225 Ft. Tape | #HW-103 **$23.88** | #HW-203 **$24.95** | #HW-303 **$30.95** |

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Fasteners work with all heat shrink type films, come in 26" long easy cut strips. Self-adhesive back sticks to frames or trim. Available in **white** or **brown,** can be painted any color. No special skills or tools needed.

### Double Sided Acrylic Tape

Made specially for window insulating systems. Provides tight, durable bond to plastic window film.

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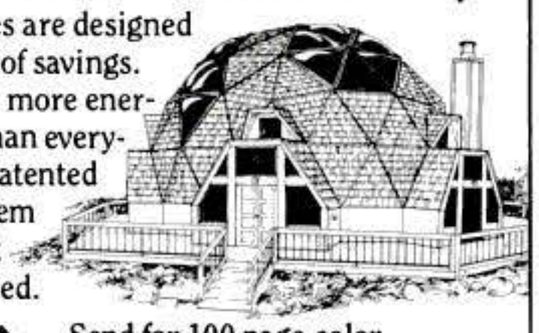

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# *Taking Care of Your Car*

**By STEVE MERCALDO**

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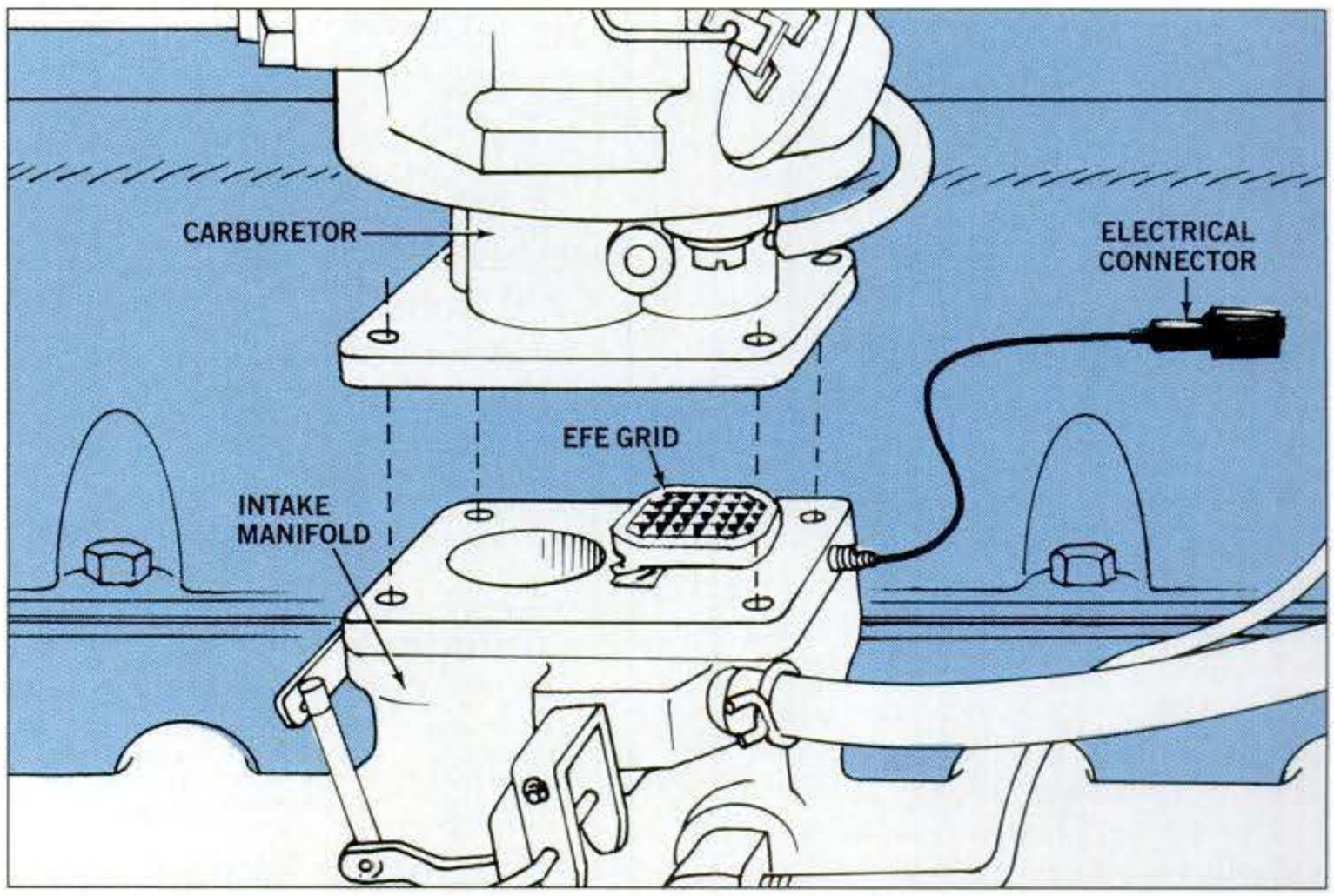
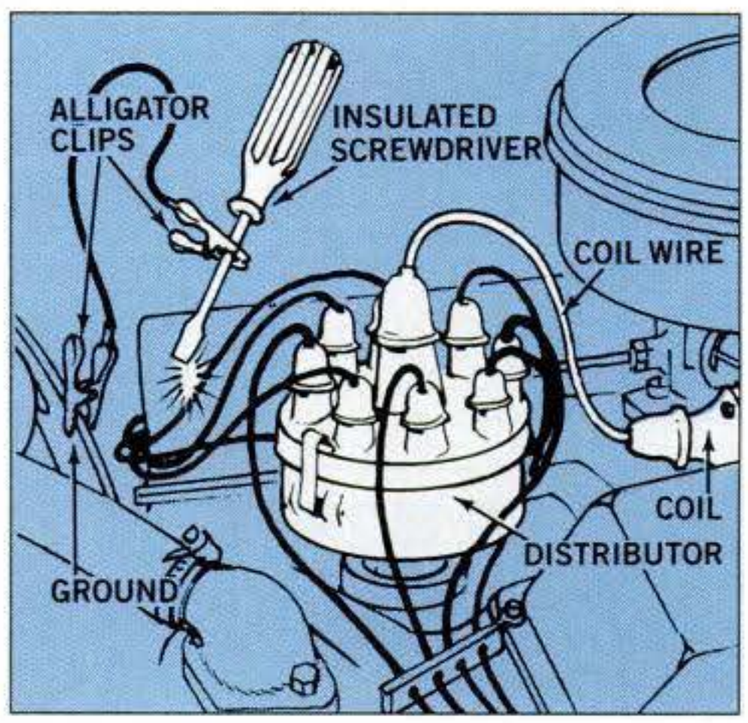


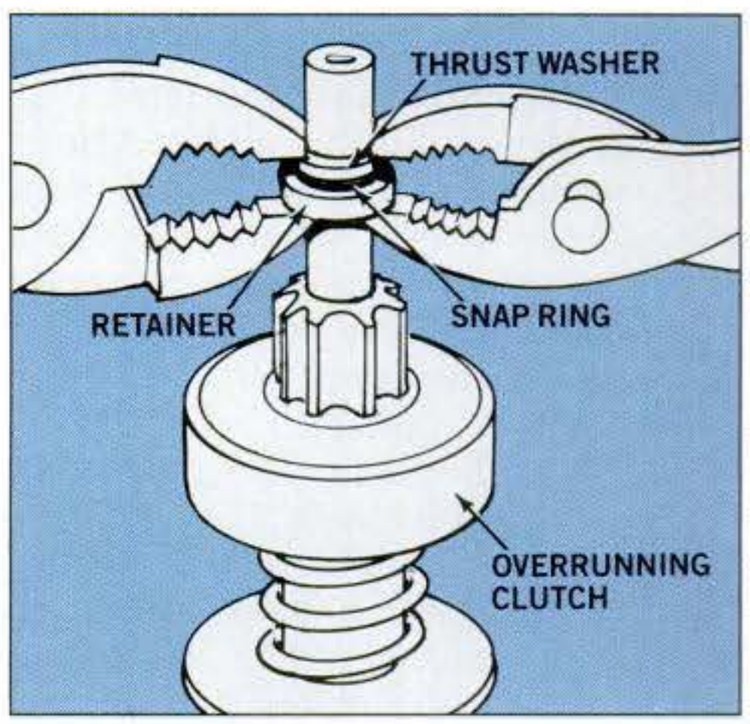

## Carburetor warmer

Some four- and six-cylinder engines use a grid-type electrical heater called an early fuel evaporator (EFE). The EFE is positioned under the carburetor. Its job is to preheat the air-fuel mixture when the engine is cold to promote smooth operation. When the engine reaches proper operating temperature, the EFE is switched off. If your car runs poorly, stalls, or hesitates when cold, check to see if it is equipped with EFE. If so, the EFE grid may be burned out or other circuit components may be damaged. Follow the repair-manual procedure to pinpoint the problem.




## Spark detective

An engine that runs rough may have an insulation break in a spark plug or coil wire. To find out if that's the problem, attach a wire to the shaft of a screwdriver with an insulated handle, and fasten the loose end of the wire to a ground. Start the engine and look for sparks as the screwdriver tip moves along the cables.




## Starter overhaul trick

Replacing the starter drive assembly on a General Motors starter can be frustrating. Engaging the drive retainer and snap ring without a special GM tool is tricky. But to get the job done, position two pliers as shown. Then squeeze both to force the snap ring into the retainer and groove in the armature shaft.



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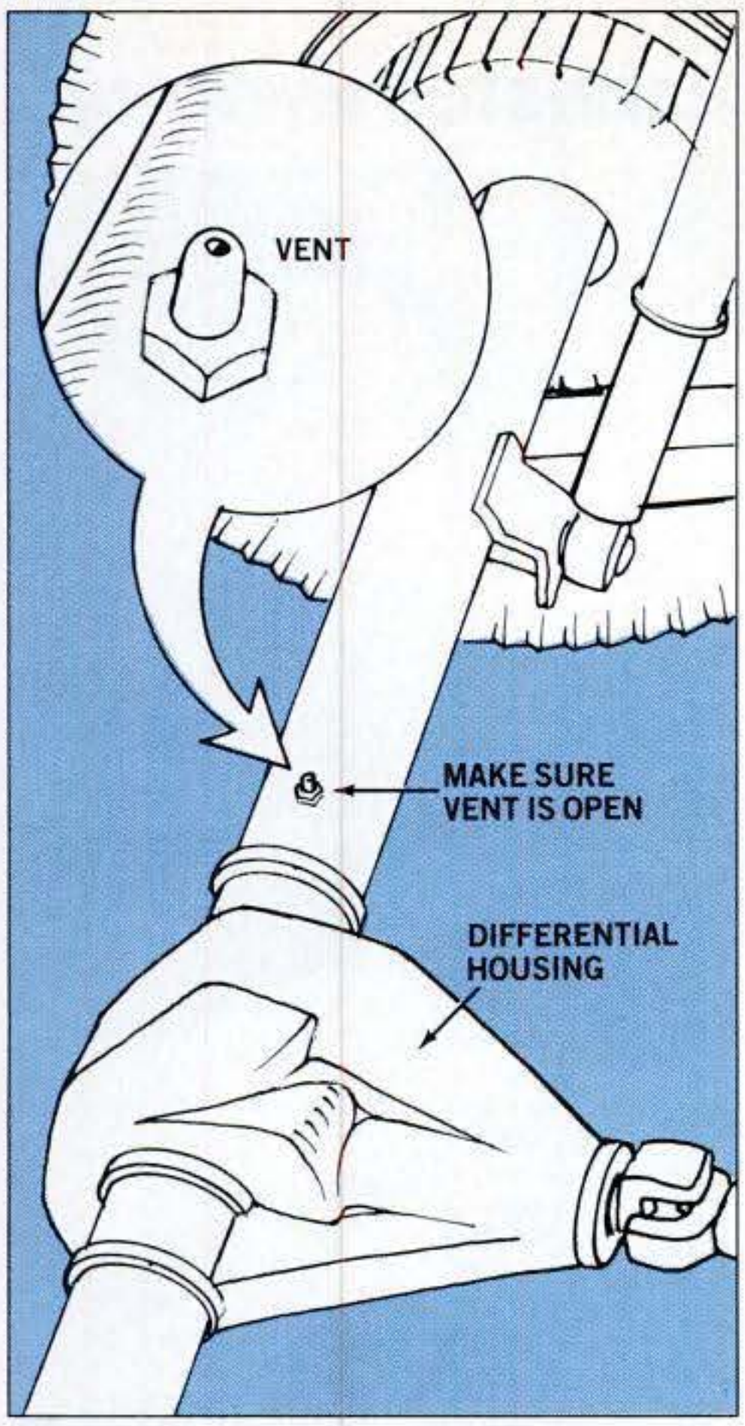
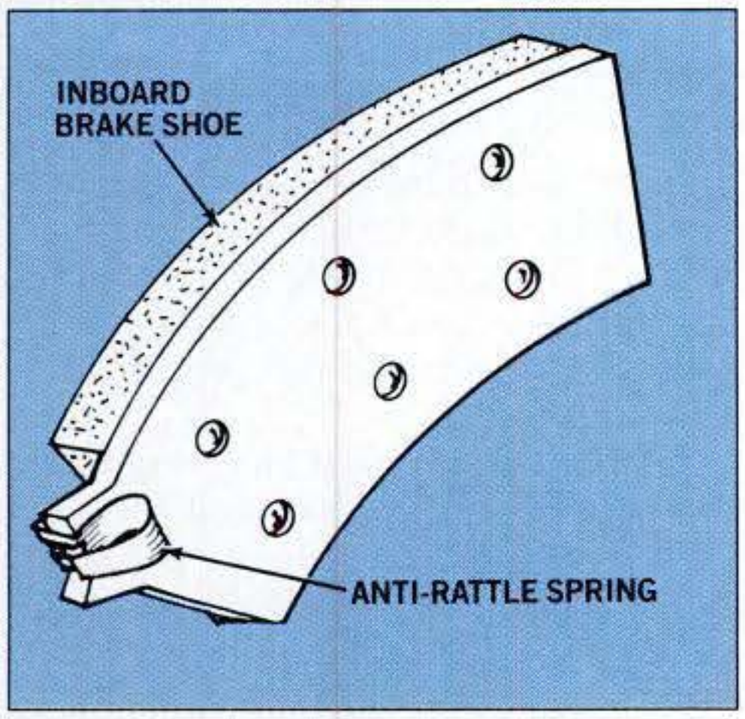



## Blown rear-end seal

Simply replacing the leaking axle seal on a rear-drive may not keep the problem from recurring. Rear differentials are vented. If the vent is clogged, heat and pressure in the housing will blow the seal again. So whenever an axle seal is replaced, you should examine the vent system for a clog.




## Rattle cure

A loose disc-brake pad can cause an annoying rattle. To determine if the rattle is brake related, drive until the rattle becomes apparent. Then, gently apply the brakes. If the noise stops, check for missing or tired anti-rattle springs. Pads designed without springs can be tightened by rebending their anti-rattle tabs.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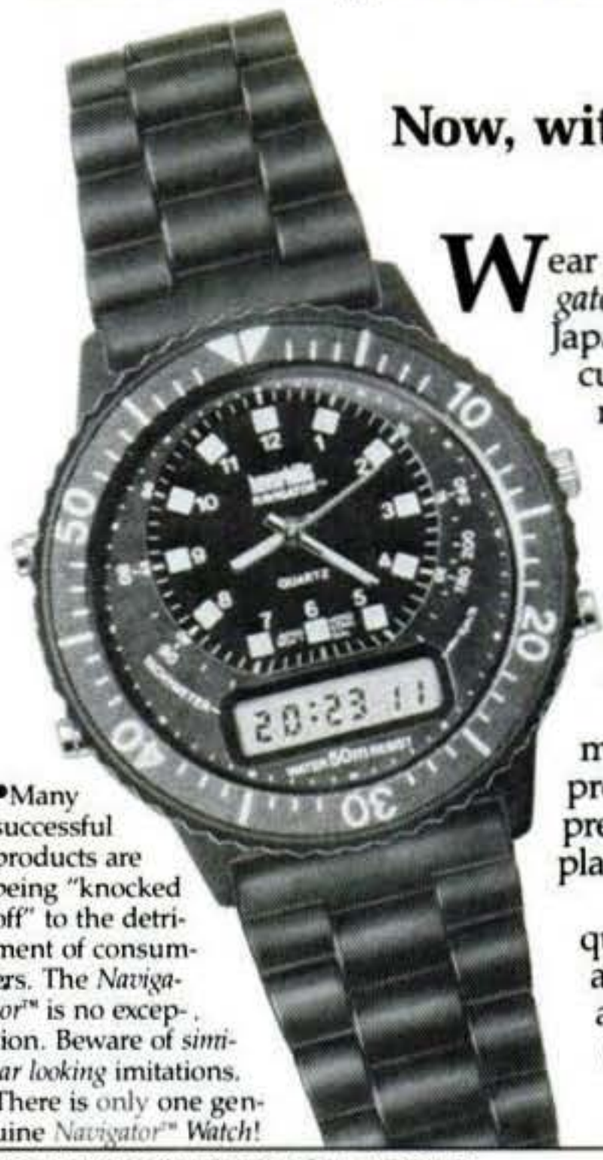

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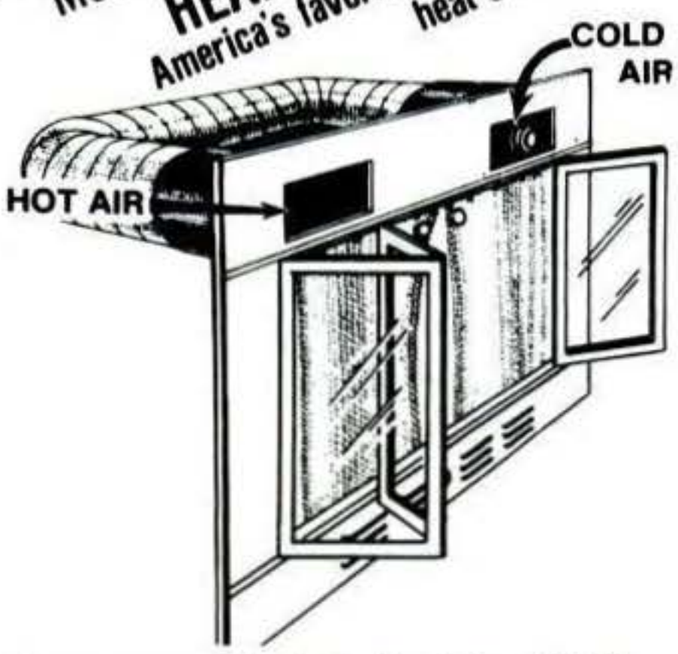


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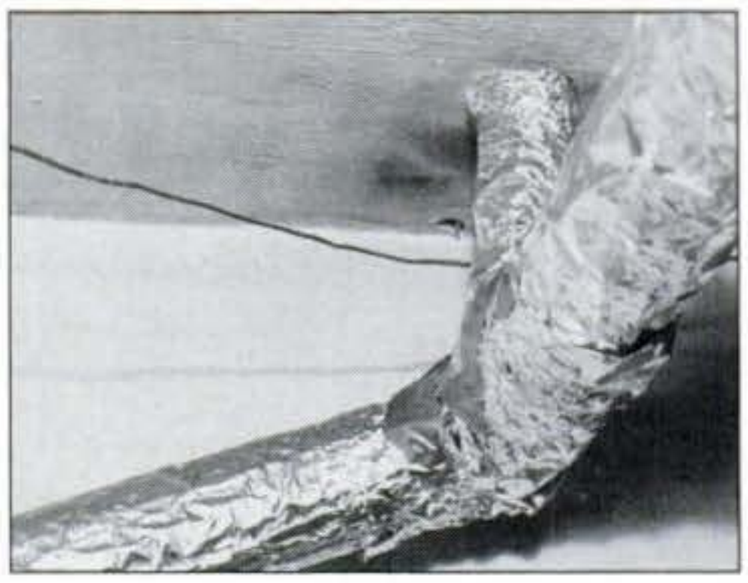

The basement heating lines of many older homes are insulated with hand-packed asbestos layers. Asbestos dust in the home can be a serious health hazard, especially if the insulation is beginning to flake.

Here's a simple yet safe way to reduce this hazard. First, add a couple of drops of liquid detergent to a plant mister filled with water. Use the finest setting, and mist pipes to settle any dust. Then drape the full length of the pipe with kitchen plastic wrap, letting the wrap gently float over the pipe, and carefully seal it. To finish, wrap the pipe with heavy-duty aluminum foil, and fold the loose edges over to make a good seal. During the process, wear a mask that controls asbestos fibers, and take special care with vertical sections of pipe that enter the ceiling.—*Gregory R. Cohen*



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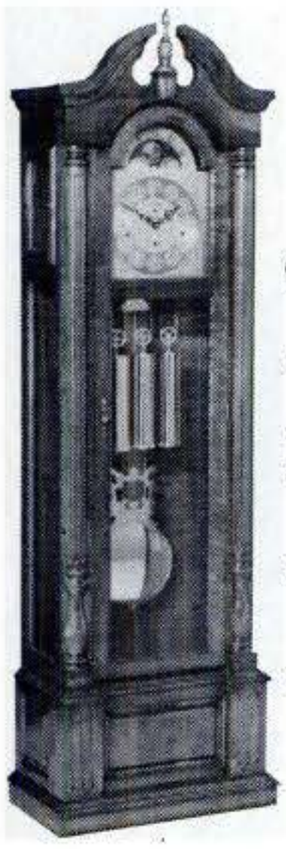

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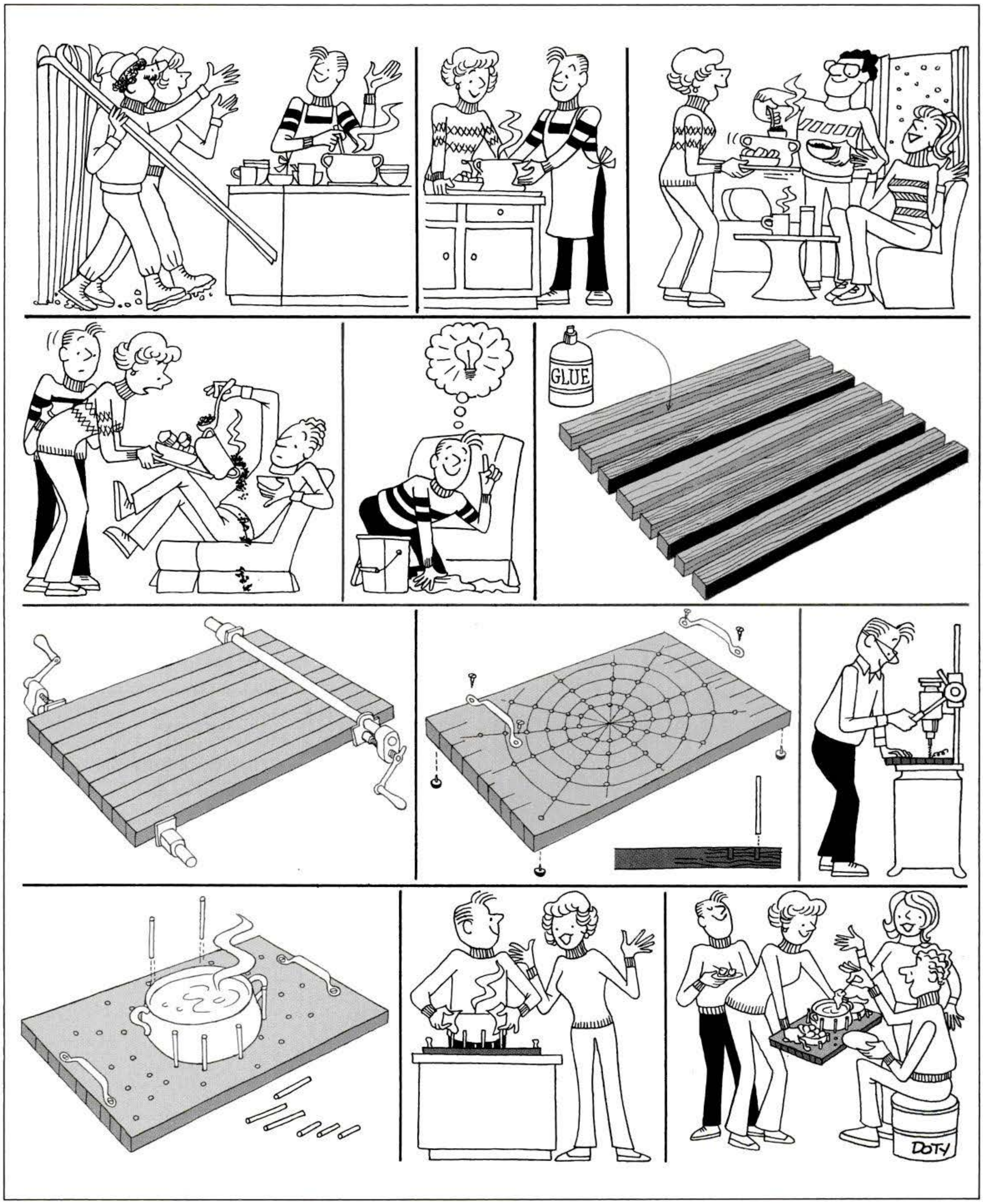




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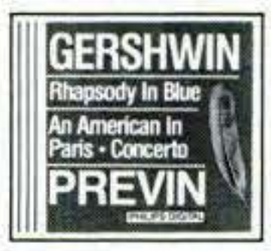

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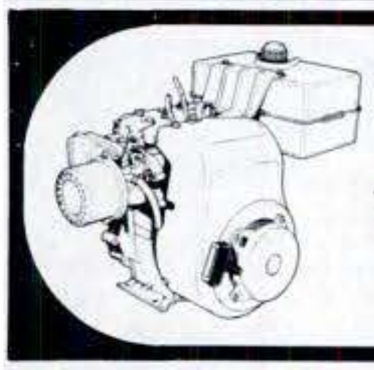

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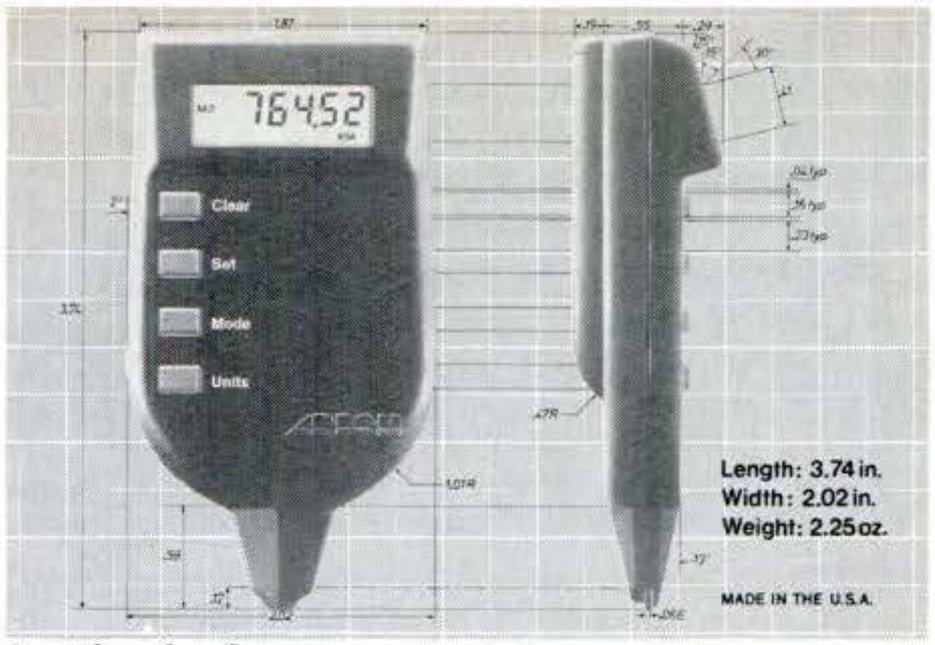


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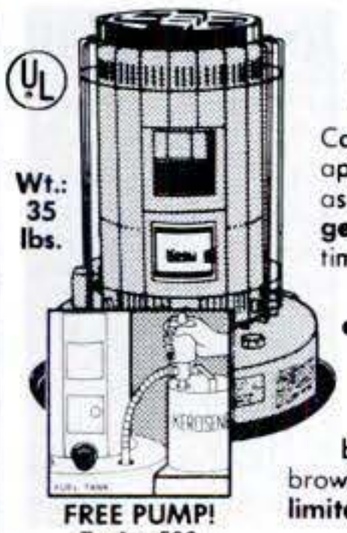

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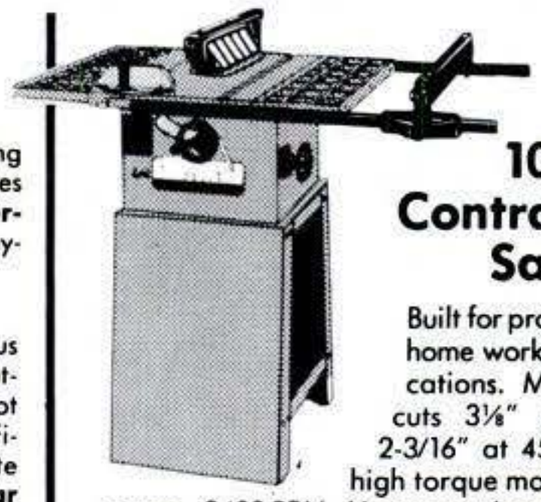

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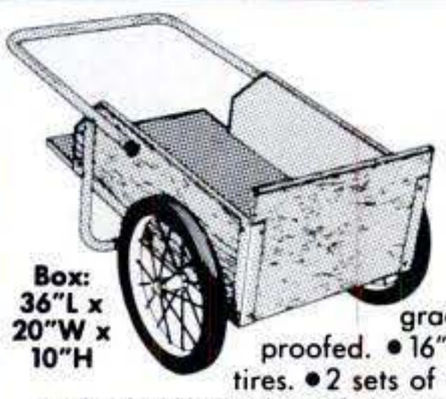

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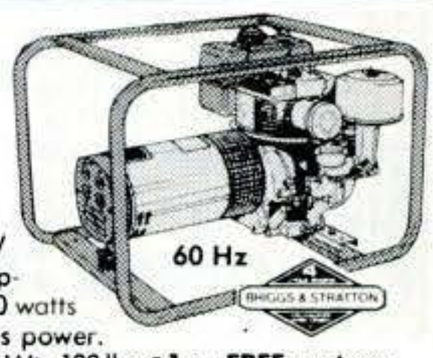


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### ealistic Replica Set Of North American Dinosaurs.

hese replicas have been carefully authenticated and crafted y the curators of the Royal Ontario Museum. Made to scale fine detail. All are molded in black and can be painted to ncrease realism. Set of 8 includes: Diplodocus 9", Lambeoaurus 6½", Pteranodon 4½", Albertosaurus 5", Parasaurolophus ", Chasmosaurus 4", Stenopterygius 5" and Stegosaurus 4" *dd $2.50 for postage and handling.* **CC36,750 $11.95**

### uild Your Own Clock Of Paper, Really Keeps Accurate Time.

ut up this heavy stock 40 page book, upply a little glue, three paper clips, nail, tring and perseverance and you have a orking clock which keeps accurate time nd has a real "tick-tock" pendulum ovement. You rewind and regulate it. **CC9687 $7.95**
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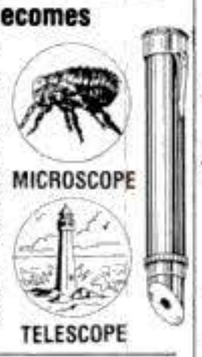
### wo-In-One 50X Microscope Becomes 10X Sportsman's Telescope.




wo precision quality instruments in ne...with fully coated optics. As a microcope you get a powerful 50X magnification for close inspection of fine detail and xamining tiny objects. Study insects, inerals, stamps, etc. Simply tilt to focus. ightly polished metal reflector reflects aximum light on the object. Extend the be and it becomes a 10X telescope... erfect for hunters, bird watchers, racing nd sports fans. **CC36,118 $14.95**
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### uild Your Own 2000° Solar Furnace With This resnel Lens And Harness The Sun's Rays!

You'll be able to use this precision lens as a solar cooker for heating food, as a kiln for pottery—and even to melt metal or for other solar experiments. Lens has an 8½" f.l., 50 lines per inch, measures 10½x10½", 1/16" thick. Unmounted lens comes with 16 page book, "Fun With Fresnel Lens". Instructions included on how to build the 360° stand and frame shown. **CC 70,533 $15.95**
*Add $2.50 for postage and handling*

### Vatch A Society Of Ants Dig Tunnels, Build Bridges And Move Mountains Before Your Eyes!

nts are the world's finest engineers...and eeing them plan and construct their intriate highways and subways is fascinating. hrough the large plastic case of the cage 10x15") of this giant ant farm, ou'll see the ant soldiers guardng the roads, the laborers carryng their load and the supply orps storing away food for the hole colony. **CC70,295 $17.95**
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### Easy To Identify Stars In The Sky With Rotating Star/Planet Locator.

Handy chart shows location of 500 stars and their relationship and location at any time. Plotted by astronomer George Lovi. With 16 page booklet of instructions and simplified celestial drawings. 8½"x8½" chart. **CC 9227 $2.50**
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### adiometer...A Space Age Sphere.

's fascinating to watch the delicate vanes ithin this 5" precision-made sphere spin aster and faster illustrating the basic prinple of solar heating. When light strikes the anes it transfers heat, and the vanes begin move. Works from direct sunlight or arficial light. An attractive "conversation iece" for your home. *Add $2.50 postage nd handling* **Reg. $6.95 CC60,082 $4.95**

### rehistoric (Pterodactyl) Flying Bird Mobile Has Giant 32 Inch Wingspan And Is Ready To Hang.

ur ompletely ssembled e-creation as a long ace, large urved neck nd a very hort ail.

gentle breeze or a slight pull of its counterweight sets this ird's giant wings in motion. The Pterodactyl roamed the earth 0 million years ago—now you can bring one into your ome or classroom. **CC36,717 $12.95**
*dd $2.50 for postage and handling.*

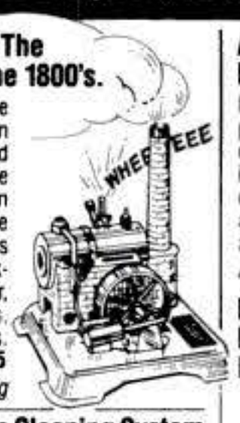
### Go Fishing With This Mighty Magnet.

Lift up to 200 lbs. Fun to use around docks and bridges. A 'must' for a boat, it helps retrieve metal objects that fall overboard. You'll be amazed at what you pull up. Wt. 2 lbs., measures 4x3¾x3¼". Made with a Poly-Vinyl Chloride coating to resist corrosion and chipping. **CC71,135 $26.95**
*Add $2.50 for postage and handling*

### ou'd Almost Think Our Whistle Was The Siren Wail Heard From A Police Car!

This superb whistle roduces a loud, iren-type wizzing oise from a delicately alanced mechanism crafted by skilled British whistle makers. The 7" extended bell piece gives extra amplification. Great at sporting events, for bike riders—anyone on the move. *Add $2.50 for postage and handling* **CC35,988 $24.95**

### Build A Working Replica Of The Steam Engine Popular In The 1800's.




Steam engines, the workhorse of the 19th century, powered machinery, farm equipment, the Stanley Steamer and trains that crossed the country. The simplest was the single stroke piston engine—power occurring when the piston moved in one direction. Kit has everything needed to recreate a working replica—from crank shafts, cylinder, piston, boiler parts, nuts, bolts, gaskets, etc. including fully illus. instructions. **CC72,202 $59.95**
*Add $2.50 for postage and handling*

### Mini-Vac, The Powerful Micro Cleaning System For Your Fine, Expensive Equipment.

Dust and dirt is the enemy of your camera, lenses, stereo, computer, typewriter and office machines. This powerful micro cleaner removes minute dust particles from hidden areas. Comes with 2 wands for getting into hard-to-reach corners, cloth bag and 2 soft brushes. Powered by a single 9V battery (not incl.).
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### Nutty Magnet Balls Jump, Wiggle... And Defy The Law Of Gravity.

There's no end to the imaginative things you can do with these magnetized "marbles"! They roll in crazy directions, making for a wild game of marbles! Great entertainment at parties; a fun way to teach children about magnetism. Package of 4 balls. **CC60,508 $2.95**
*Add $1.00 for postage and handling*

### Powerful Tire Inflator Pumps Instant Air—When And Where You Need It.

A must for every safety-minded motorist. Deluxe Mini Air Compressor delivers a full 150 psi of air pressure—enough to inflate your auto tire. Simple to operate. The 10 ft. cord plugs into your car's cigarette lighter. Set the desired air pressure and snap the air hose into your tire valve. The inflator will automatically stop when the preset air pressure is reached. And, you save on costly service calls, gas mileage is increased and tire wear is reduced with properly inflated tires. Many other uses too—inflates bicycle tires, sporting equipment, inflatable boats and air mattresses. ***Reg. $27.95***
*Add $2.50 for postage and handling* **CC34,071 $24.95**

### Flying Bird From France.

This marvelous bird will bring hours of fun. Has a 16" wingspan and can fly up to 40 ft. high and a distance of 150 ft. Power is supplied by twist motion of rubber band. Adjust for up, down, swooping flight. Made of strong mylar, durable polypropylene with rubber beak. **CC42,720 $7.95**
*Add $2.50 for postage and handling*

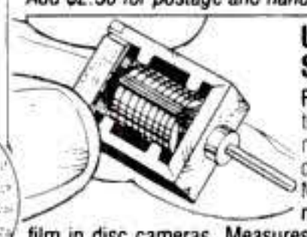
### Duplicate Most Any Object In Detail With Multi-Use Latex Rubber Mold Compound.

Make replicas of most any object, duplicating the finest detail—coins, medallions, charms, figurines and more. Form flexible, durable molds. Use with plaster or expandable foams. **Quart Size. CC42,446 $15.95**
*Add $2.50 for postage and handling*

### Worlds Smallest Fluorescent Blacklight Fits In Shirt Pocket.

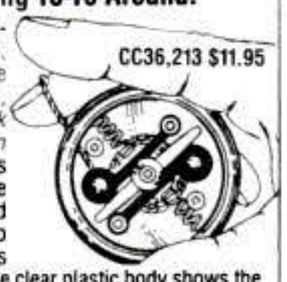
This mini blacklight will detect check forgeries by illuminating bleaches—shows where fluorescent inks are used in art forgeries—ideal for rock and mineral collectors—perfect for night hunters of bugs and butterflies. 2¼ x ¾ x 7", weighs only 3½ oz. Requires 4 "AA" batteries (not incl.). 4 watts. **CC35,485 $29.95**
*Add $2.50 for postage and handling*

### Ultra Mini Motors For Science Fair Projects.



For the hobbyist with imagination there are many uses; with mini toys, robot component, displays, demonstrations, etc. Micro size motors were originally designed to advance the film in disc cameras. Measures only ⅞ L x 11/16 W x ⅜" H with a 1/16" dia. x 5/16" long shaft. At 3 volts 200ma, they will do 7500 rpms. **Solar cell to run motor, CC31,276 $5.95**
**Pkg. 25 CC36,341 $18.75 Pkg. 100 CC36,342 $60**
*Add $2.50 for postage and handling*

### Our Intelligent Yo-Yo With A "Brain." It's The Longest Spinning Yo-Yo Around!



CC36,213 $11.95

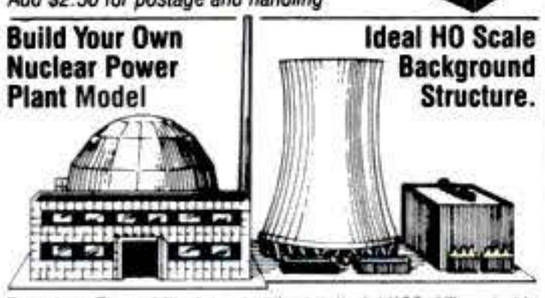
A simple flick of the wrist preprograms this patented yo-yo, allowing it to spin freely at the end of the string. Suspended, you can do tricks, such as *"Walk The Dog," "Rock The Baby," "Brain Twisters"* and more. It operates on a centrifugal clutch principle that allows it to spin faster and longer than any other yo-yo before returning to the user's hand. Precision engineered, the clear plastic body shows the clutch in action. *Add $2.50 for postage and handling.*

### Aquarium Sea Magic That Does Not Take Up An Ocean Of Space.

Mini aquarium is a beautifully fashioned accent piece for home or office. Pump and airhose are cleverly concealed in the 6" square walnut finished base. Aquarium is 13" tall. Unbreakable circular acrylic tank. Includes 110V air pump, aquarium gravel and greenery. All you need to add are the fish. **CC35,971 $19.95**
*Add $2.50 for postage and handling*

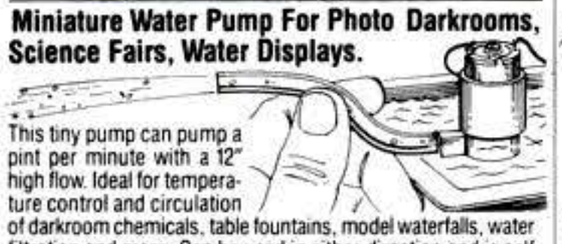
### Build Your Own Nuclear Power Plant Model

### Ideal HO Scale Background Structure.



Based on Three Mile Island, this detailed 1/160 "N" scale kit has 79 parts molded in colors. Includes containment building, cooling tower and generator station on a 14 x 16" base. Stack is 4¾" high. For ages 12 and over. **CC36,718 $11.50**
*Add $2.50 for postage and handling.*

### Miniature Water Pump For Photo Darkrooms, Science Fairs, Water Displays.

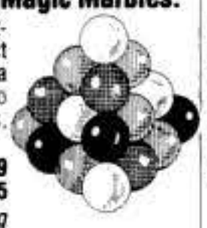


This tiny pump can pump a pint per minute with a 12" high flow. Ideal for temperature control and circulation of darkroom chemicals, table fountains, model waterfalls, water filtration and more. Can be used in either direction and is self priming. Operates on 2 flashlight batteries (not incl.), runs up to 48 hours before battery change is required. 4" tube incl.
*Add $2.50 for postage and handling.* **CC50,345 $6.95**

### Here's An Emergency Radio/Flashlight That Never Needs Batteries Or House Current.

When power failure strikes, and your batteries go dead, Dynamo Radio/Flashlight comes to the rescue. A unique, self-contained hand-crank generator provides sufficient power for hours of important AM/FM radio emergency information and a powerful bright light from its flashlight. A handy tagalong (without any emergency) at sporting events, camping or on vacation. *Add $2.50 for postage and handling.* **Reg. $39.95 CC35,420 $34.95**

### Fun And Intriguing! You'll Play For Hours With These Colorful Magnetic Magic Marbles.



Build a mountain or odd geometric patterns with these fascinating, high impact plastic marbles. Each marble has both a negative and positive pole. A challenge to your imagination. Fun for youngsters, adults, too! 20 marbles per package.
**CC34,968 (Package of 20) $3.49**
**CC27,898 (Package of 100) $14.95**
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### Easy To Make Your Own Transparent Filters For Creative Photo Effects.

Vibrant colors for striking photographic effects. Heat resistant, 0.0005 to 0.10 thickness. A practical alternate to expensive 'store bought' filters. ***Available in sheets or booklet.*** Booklet of 44 sheets, each a different color.
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**CC82,010 Gold Amber; CC82,039 Dk. Urban Blue; CC82,031 Daylight Blue; CC82,034 Dk. Med. Blue; CC82,038 Lt. Md. Blue; CC82,000 Frost; CC82,040 Lt. Gr.; CC82,041 Med. Gr.; CC82,043 Yel. Green; CC82,004 Md. Lemon; CC82,012 Orange; CC82,029 Md. Purple; CC82,015 Med. Red.**
*Add $2.50 for postage and handling*

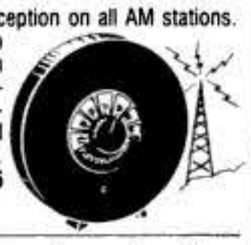
### 100 Piece Peg Board Hardware Bonanza.

**SPECIAL PURCHASE!** Brand new industrial peg board hardware at a very special savings. Our bargain pack contains 95 "J" hooks and 5 six-place "screwdriver" racks. Organize your workshop, lab, school room or office at a fraction of the usual cost. **CC36,835 $7.95**
*Add $2.50 for postage and handling.*

### Nostalgic Miner's Lantern Will Brighten Your Night.

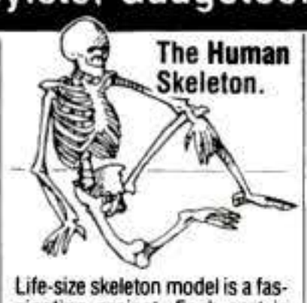
This true authentic reproduction of a coal miner's lantern of a bygone era will add charm to your study or den. Handcrafted in solid brass, the carbide lantern and 4" reflector produces an incredibly bright light. Starts easily with the strike of a flint, uses carbide fuel (comes with a 2 lb. fuel supply). Measures 5½" tall. **CC34,744 $24.95**
*Add $2.50 for postage and handling*

### Great AM Radio Reception With Select-A-Tenna. Listen To Station WOR N.Y. When In Boston.



You'll now get excellent radio reception on all AM stations. Select-A-Tenna turns your AM radio into a powerful receiver. Used in Alaska to pull in stations from continental U.S. Employs mutually inductive coupling. Mini-jack and plug with 50 ft. of hook-up wire. 10¾" dia. **CC72,147 $39.95**
*Add $2.50 for postage and handl'g.*

### The Human Skeleton.

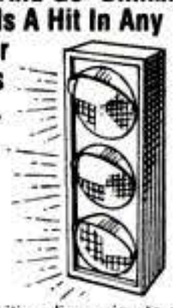


Life-size skeleton model is a fascinating project. Each part is anatomically labeled. Sturdy cardboard paper construction. 8 hour assembly time. Fully posable, universal movement and extension/flexion. Can be used for classroom or science project. **CC35,966 $49.95**
*Add $2.50 postage & handling*

### Our Amazing Happy Bird Never Stops Drinking!

Fascinating to watch. Simply duck the bird's head into a glass of water to begin happy birds bobbing motion. Then the bird takes over, continuously dipping into the water for a drink.
**CC60,778 $3.50**
*Add $1.50 postage and handling*

### "Stop And Go" Blinking Light Is A Hit In Any Den Or Child's Room.



Adds exciting dimension to any room, college dorm or as a super retail store display. ***18" light blinks yellow, red and green at random.*** Wood frame, vinyl hood, 110 V. **CC35,987 $29.95**
*Add $2.50 postage & handling*

### Our "Bug Box".

Here's a unique way of observing insects and specimens. Acrylic boxes have a magnifier built into the cover. Available in 2 sizes, ***packed in bags of 25 boxes.***
**1" square box with 4X magnifier CC35,048 $11.95**
**1½" square box with 3X magnifier CC35,049 $22.95**
*Add $2.50 postage & handling*

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### Make Your Own Personal Solar Music Box. Plays A Merry Tune, Powered By Heat From A Light Bulb Or The Sun.

Create your own music box with this precision, mini movement, powwered by a 400mA solar cell. 2¼ x 1⅞", 4" wire leads.
***Choice of 5 tunes.*** **Each $10.95**
**CC35,218 "It's A Small World"**
**CC35,215 "Memory" (From "Cats")**
**CC35,219 "Teach The World To Sing"; CC35,216 "Love Story"**
**CC35,217 "Lara's Theme" (please specify)**
**Encapsulated solar cell,** protected cell to drive above movement, 1¾" x 2⅞", 36" leads. **CC35,397 $8.00**
*Add $2.50 for postage and handling*

### A Simple Touch, Your Lamp Is Lit! Another Touch, Your Lamp Goes Off!

Fantastic! ***Works on all lamps.*** No more fumbling in the dark for the light switch. Gives 3 levels of brightness from ***any*** incandescent bulb. To turn on your lamp, a simple touch as a night light; twice for half brightness; three times for full brightness. The fourth touch turns it off. UL listed. **CC35,997 $17.95**
*Add $2.50 for postage and handling*

### This Clever Gadget Will Tell You How High You Are.

Whether you're driving cross country or hiking in the mountains, this Altimeter will tell you how high you are. Shows elevation from sea level to 15,000 feet. Can be mounted to dashboard with self sticking tape (incl.) or has pre-drilled screw holes. Also has built-in barometer. With case for hikers and bikers. ***Reg. $24.95***
*Add $2.50 for postage and handling.* **CC34,544 $19.95**

### 65 Piece Lab Set Assortment—Special Buy!

A super bargain every chemist can use in the lab and at home. It's surplus, but brand new. Giant assortment includes test tubes, vials, measuring cups, bottles with caps, flasks, beakers, pipettes, squeeze bottles and more. Assorted sizes and quantities. **CC35,474 $24.95**
*Add $2.50 for postage and handling*

### Pocket Pointer—Handy Aid For Teachers, Lecturers, Executives.

Here's a handy accessory for teachers and executives—unbeatable for pointing to highlights on movies, charts, blackboard lessons,

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demonstrations. ***Extends to 25", collapses to only 5".*** Chrome with pocket clip and pointer cap. **CC35,965 $3.95**
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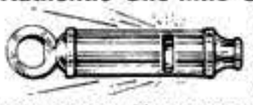
### Protection From Would Be Attackers With Authentic 'One Mile' Scotland Yard Whistle.



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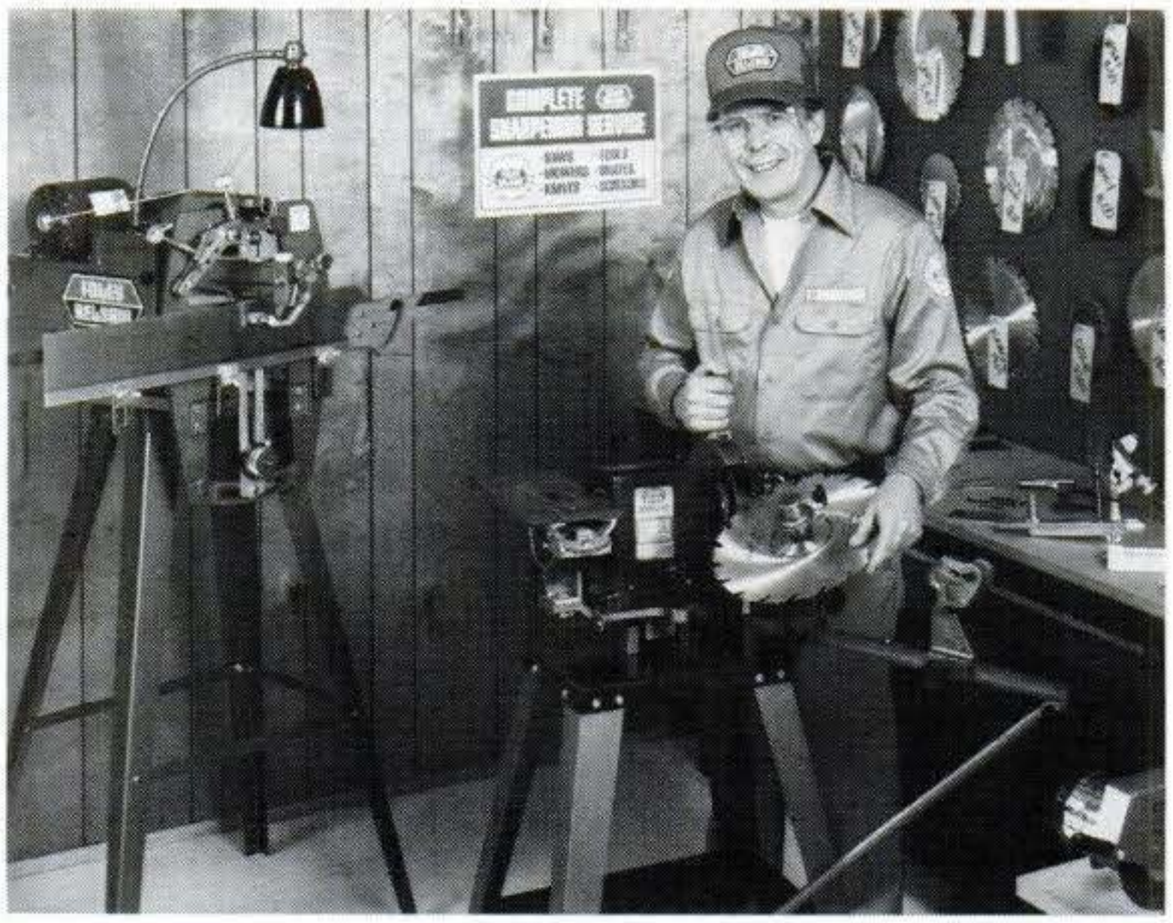

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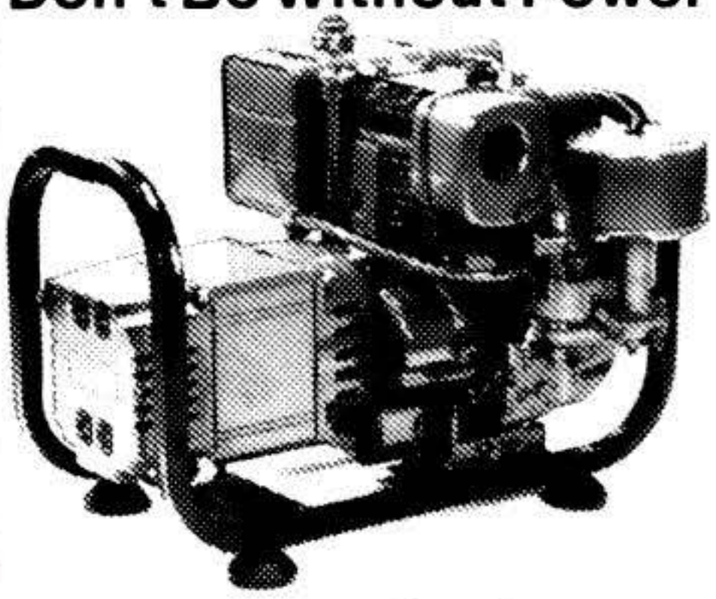

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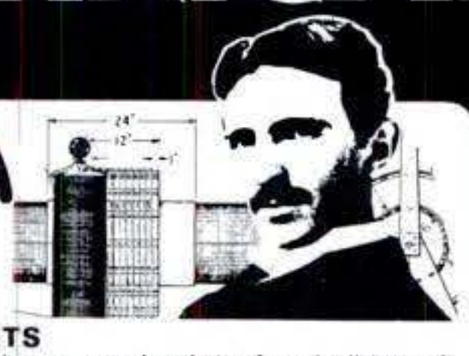

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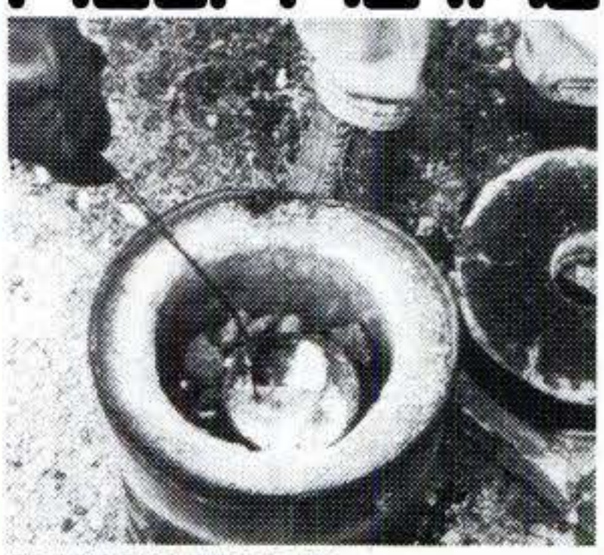

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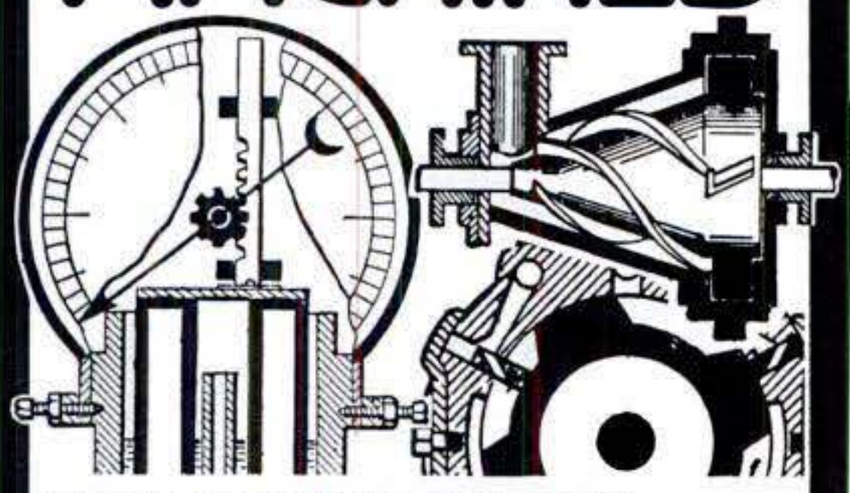

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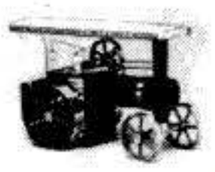

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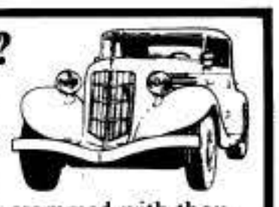

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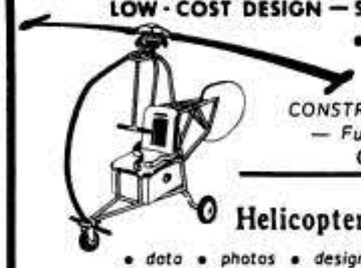

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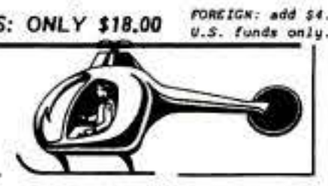

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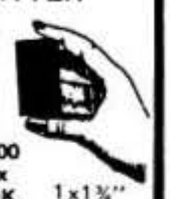

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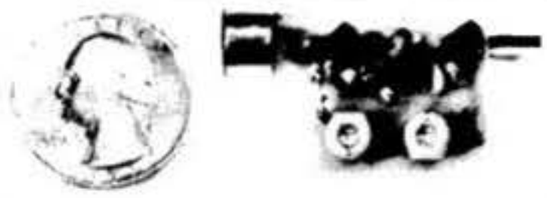

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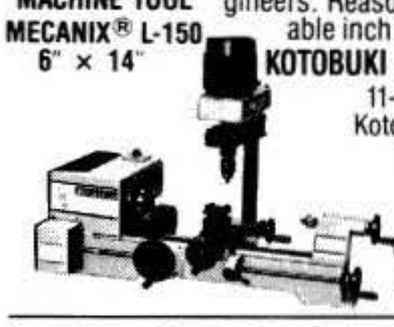

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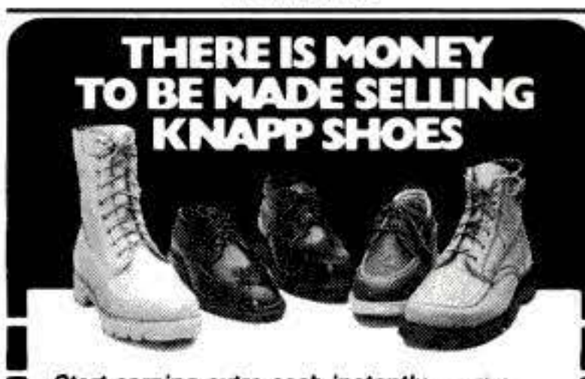
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# Product Information

Booklets, catalogs, and folders listed below provide reliable information, illustrations, and specifications to help you in planning the purchase of a variety of products or services offered by these dependable companies. The convenient order form will save you time and postage. **Orders will not be processed unless accompanied by the $1 handling fee. For your safety, please do not send cash.**

**1101 Robotics** A brochure from Access Software describes its series of robotic workshops for the home computer. The workshops consist of various software programs for experiments and projects in robotics, engineering, and science. Free

**1102 Electric Generators** The color product literature from Ag-Tronic details the features and uses of Powermate Electric Generators. The line ranges from 500- to 7,000-watt generators, which are ideal for recreation, construction, and home power emergencies. Free

**1103 Hunting Equipment** A new full-color catalog from Browning lists the company's complete line of sporting arms; gun accessories, safes, and cases; archery equipment; clothing; boots; and knives. Free

**1104 Binoculars** A fully illustrated brochure from Bushnell, a division of Bausch & Lomb, describes its line of binoculars, explains terminology, and provides technical data. Free

**1105 High-tech Newsletter** Join professors, engineers, and other professionals with the CASIOLINK, Casio's high-tech newsletter. The latest in electronic products are discussed, and useful applications are contributed by you, the experts. $2

**1106 Wood Staining and Refinishing** Deft's 24-page four-color booklet gives helpful tips for better wood-staining and finishing results. Using Deft products, learn how to apply a bar-top finish in hours, prevent wood from yellowing, create stain colors, and more. 50¢

**1107 Drip Irrigation** An informative booklet from Drip Irrigation Garden tells how to get the most from your garden with minimal water use. The literature describes how drip irrigation works, and how to install and map out your own system. Free

**1108 Digital Multimeters** Trouble-shoot electrical circuits with this 16-page brochure from John Fluke Mfg. Co. Charts and drawings show how to use digital multimeters on basic AC circuits, motors, circuit breakers, and more. Free

**1109 Cutting Tools** A new 104-page Freud catalog displays its finest-quality hand tools and carbide cutting tools, from chisels to saw blades to router bits. $1

**1110 Solar Heating** A solar planning kit from Hanson Energy Products describes how its TA-3 space-heating system brings you the free warmth of the sun, saving you money on your energy bills. $1

**1111 Thermostats** A four-color pamphlet from Hunter Fan Co. describes the features and energy-saving benefits of the Energy Monitor II Plus programmable thermostat. The system installs in just 30 minutes with only a screwdriver. Free

**1112 Home Heating** A four-color 10-page brochure from Kent Heating describes its full line of wood stoves and fireplace inserts. The literature includes complete specifications, installation clearance requirements, operating tips, and technical data. Free

**1113 Residential Locksets** This full-color brochure from Kwikset describes the company's unique designs and architectural lockset styles for the home. Doorknobs, levers, entrance handle sets, and deadlocks are shown. 35¢

**1114 Chain-saw Accessories** Literature from Lewis Products Co. describes its Lewis Winch and Lewis Mole chain-saw accessories that fit all saws using a 3/8-inch chain. The Winch pulls 4,000 pounds with 150 feet of 3/16-inch aircraft cable (8,000 with a snatch block), and is completely portable. The Mole is a post-hole digger using earth drills up to 9 inches and wood drills up to 4 inches. Free

**1115 Cedar Homes** Two plan books from Lindal Cedar Homes lists hundreds of plans, color photographs, and ideas for your natural cedar home. Included is a unique planning grid to get you started. $7

**1116 Overload Control** A color brochure from Load Toter Mfg. Co. explains its patented pickup-truck overload control. The company says the system increases payload capacity 100 percent and acts as an anti-sway and stabilizer bar, eliminating fishtailing and bottoming out. The controller comes into play only when the truck is loaded; it installs in 30 minutes and is guaranteed for life. 25¢

**1117 Locksets** A new full-color 10-page catalog from M. A. G. Engineering and Mfg. highlights its unique security reinforcement hardware for residential doors, locks, and frames. Detailed applications and specifications are enclosed along with a suggested retail price list. $1

**1118 Digital Video** The full-color brochure from MultiVision Products describes the MultiVision 3.1, which turns any TV into a remote-controlled digital MTS stereo set. Two channels can be viewed simultaneously, multiple video sources can be swapped, and automatic scanning and action freezing are possible on a variable-size, movable picture. An audio amplifier drives stereo speakers directly. Free

**1119 Home Video** A consumer information kit from Sega of America details the Sega Master System home video games. The literature describes the system and available software, and introduces the revolutionary Sega Cards—software games that fit in your pocket. Free

**1120 Electronic Keyboards** A four-page brochure from Yamaha International lists 10 portable electronic keyboards, with a description and picture of each. The keyboards are available with optional accessories. Free

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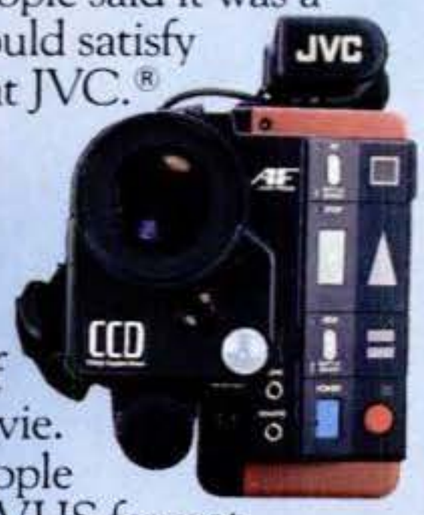


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